AD________________

Award Number: DAMD17-98-2-8015

TITLE: The Gulf Coastal Plain Ecosystem Partnership: Development of Conservation Strategies and Prjoects

PRINCIPAL INVESTIGATOR: Vernon Compton

CONTRACTING ORGANIZATION: The Nature Conservancy
Arlington, Virginia 22209

REPORT DATE: May 2000

TYPE OF REPORT: Final

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;
distribution unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

DTIC QUALITY INSPECTED 2

DTIC QUALITY INSPECTED 1

20000516 120

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE
May 2000

3. REPORT TYPE AND DATES COVERED
Final (5 May 98 - 4 May 00)

4. TITLE AND SUBTITLE
The Gulf Coastal Plain Ecosystem Partnership: Development of Conservation Strategies and Projects

5. FUNDING NUMBERS
DAMD17-98-2-8015

6. AUTHOR(S)
Vernon Compton

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
The Nature Conservancy
Arlington, Virginia 22209

E-MAIL:gcpep@bellsouth.net

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

Report contains color pictures, graphs, and maps.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 Words)***

The Gulf Coastal Plain Ecosystem Partnership (GCPEP) is a unique collaboration among Eglin AFB, The Nature Conservancy (TNC), Champion International Corporation, Blackwater River State Forest, Northwest Florida Water Management District and National Forests in Alabama and Florida, who cooperate under the auspices of a 1996 multi party Memorandum of Understanding. The partners manage more than 840,000 acres in one of the most important conservation landscapes in the Southeast. Of the 115 species of plants and animals and 297 natural communities identified by TNC as being targets for conservation action in the 42 million acre Eastern Gulf Coastal Plain ecoregion, 37% of species and 38% of natural communities occur on GCPEP lands, despite GCPEP being only 2% of the ecoregional land area. The GCPEP has undertaken a joint planning process, including identifying site conservation targets and assessing the stresses and sources of stress. Eighteen total conservation targets were identified, ranging from single species (e.g., red-cockaded woodpeckers) to large, matrix-forming ecosystem types, (e.g., longleaf pine matrix). Major threats to targets include residential development, incompatible fire, forestry and agricultural practices, unstable management funding and roads/utility corridors. Cooperative conservation strategies were developed in the project's second phase.

14. SUBJECT TERMS

Key words: Gulf Coastal Plain Ecosystem Partnership, Eglin Air Force Base, The Nature Conservancy, ecoregion, conservation targets, threats

15. NUMBER OF PAGES
1528

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

NOTICES

Cooperative Agreement Number DAMD 17-98-2-8015

Effort sponsored by the Legacy Resource Management Program of the Department of Defense, U.S. Army Medical Research Acquisition Activity, U.S. Army Medical Research and Materiel Command, Department of the Army under Cooperative Agreement number DAMD 17-98-2-8015. The U.S. Government is authorized to reproduce and distribute reprints for governmental purposes notwithstanding any copyright notation thereon.

The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily the official policies or endorsements, either expressed or implied, of the USAMRAA, U.S. Army, Department of Defense, or the U.S. Government.

Distribution Statement A. Approved for public release: distribution unlimited.

May 2, 2000

The Nature Conservancy®

© The Nature Conservancy

ACKNOWLEDGMENTS

We gratefully acknowledge the support of the Legacy Resource Management Program of the Department of Defense for their support. We also recognize the support of the Elizabeth Ordway Dunn Foundation, the Turner Foundation, Camp Younts Foundation, The Center For Compatible Economic Development-The Nature Conservancy, National Forests in Alabama and the Florida Chapter of The Nature Conservancy.

The Gulf Coastal Plain Ecosystem Partnership Project particularly acknowledges the assistance and support of the Natural Resources Division of Eglin Air Force Base in playing a lead role in the Partnership. We are especially grateful to Richard McWhite for his leadership and continued support of this project and his participation on the Partner's Steering Committee as Eglin's primary representative. We also thank Carl Petrick and the many other people at Eglin who facilitate the project, for their support, involvement and insight at critical points along the way.

We are especially grateful to each of the other Partners and their Steering Committee members for their commitment to and support of this project. We thank Champion International Corporation for their generous contribution of office space for the GCPEP Staff. We thank Larry Davis, Joann Cox, Arden Shropshire, Ad Platt, Joe Cox and everyone at the Jay, FL office from Champion International. We thank Earl Peterson, John Webster, Dennis Hardin, Tom Serviss, Tom Arrington, Tom LeDew and Sonny Greene of Florida Division of Forestry and Blackwater River State Forest. We thank Jim Gooder, John Yancey, Gary Taylor and Rick Lint of Conecuh National Forest. We thank Steve Brown, John Valenta and Bill Cleckley of Northwest Florida Water Management District. We thank Marsha Kearney, Andy Colaninno, Art Rohrbacher and Kathleen Atkinson of National Forests in Florida.

We thank Bob Bendick, Jim Murrian, Greg Low, Jora Young, Hans Karies, Debbie Keller, Linda Solash-Reed, Kathy Freeland, Izzie Berkson, Barbara Allison, Gloria McCarthy, Maria Melchiori, Laura Butterfield, Bridgette Clements, Lourdes Quevedo, Eppie Bang, Cynthia Taylor, Evelyn DelaRosa, Wendy Henry, Cluny Madison, Frances Nevill, Cheryl Mall, Erica Kasprzyk-Bristol, Michael Cantillo, Louis Provencher, Krista Galley, Brenda Herring, Andrea Litt, Jeff and Senta McAdoo, Nancy Gobris, Doria Gordon, Rob Sutter, Marianne Gengenbach, Wendy Caster, Betsy Donley, Richard Hilsenbeck, Kyle Jones, Terry Sullivan, John Pescatello, Ruth Mathews, Jon Blanchard, Wendy Allen and many other people from The Nature Conservancy for their ongoing support, advice and assistance throughout.

We thank the governmental and non-governmental agencies and the many committed individuals who have contributed time, expertise, funding and materials for their support of the Gulf Coastal Plain Ecosystem Partnership.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FOREWORD

Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the U.S. Army.

VLC Where copyrighted material is quoted, permission has been obtained to use such material.

___ Where material from documents designated for limited distribution is quoted, permission has been obtained to use the material.

___ Citations of commercial organizations and trade names in this report do not constitute an official Department of Army endorsement or approval of the products or services of these organizations.

N/A In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and use of Laboratory Animals of the Institute of Laboratory Resources, national Research Council (NIH Publication No. 86-23, Revised 1985).

N/A For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

N/A In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

N/A In the conduct of research utilizing recombinant DNA, the investigator(s) adhered to the NIH Guidelines for Research Involving Recombinant DNA Molecules.

N/A In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories.

Vernon Compton May 2, 2000

PI - Signature Date

PREFACE

This report is intended as a summary of the Gulf Coastal Plain Ecosystem Partnership (GCPEP) from May 1998-May 2000. We have directed our style to those with technical expertise in natural resources, forest, wildlife and fire management. We have written this report in chapters that focus on the completion of the conservation planning process and the implementation of projects. This report focuses on the conservation of biological diversity in the context of the GCPEP.

The body of the report contains nine chapters that summarize the planning and project process to date and then offers lessons learned and conclusions. Chapter one ("Introduction") provides a brief overview and background of the GCPEP and the planning process. Chapter two ("Conservation from an ecoregional perspective") provides an analysis of the conservation significance of the partnership, both individually and collectively. Chapter three ("Socioeconomic assessment") provides an overview of the regional human context. Chapter four ("Sustaining biodiversity at sites") provides an overview of site conservation planning to date, including conservation target selection and threats to the targets. Chapters five and six ("GCPEP planning") summarize the results of the initial planning process, including the initial conservation targets selected. Chapters seven and eight ("GCPEP planning") summarize the finalization of operational guidelines and the implementation of projects. Chapter nine ("Conclusions") provides a brief overview of project accomplishments and lessons learned.

CHAPTER 1. INTRODUCTION

The Gulf Coastal Plain Ecosystem Partnership

The purpose of this final report is to summarize the project entitled, "The Gulf Coastal Plain Ecosystem Partnership: Development of Strategies and Projects," supported in part by the Legacy Natural Resource Program of the Department of Defense. The sponsoring Air Force installation is Eglin Air Force Base ("Eglin") located in the western Florida Panhandle approximately 20 km east of Pensacola, Florida. Eglin is a key member of the Gulf Coastal Plain Ecosystem Partnership, under which this project is organized.

The Gulf Coastal Plain Ecosystem Partnership ("GCPEP" or "Partnership") is a unique collaboration among Eglin, The Nature Conservancy ("TNC"), Champion International Corporation ("Champion"), Blackwater River State Forest ("Blackwater"), Northwest Florida Water Management District ("NWFWMD") and National Forests in Alabama and Florida ("Conecuh" and "Apalachicola"), who cooperate under the auspices of a 1996 multi-party Memorandum of Understanding. Together, these partners manage more than 840,000 acres in one of the most important conservation landscapes in the Southeast. In 1998-2000, The Nature Conservancy, as a member of GCPEP, hired a local Project Director, Vernon Compton, a Project Administrator, Perrin Penniman, an Aquatic Specialist, Stephanie Davis and a Project Conservation Ecologist to facilitate planning and project implementation under the direction of a Steering Committee made up of representatives from each GCPEP organization.

Conservation planning at the ecoregional scale

One of the most important goals of this project is to develop a common set of voluntary conservation strategies consistent with each partner's individual legal mandates, mission and objectives. Cooperative conservation strategies, when developed, will explicitly recognize that collectively the Partners share interconnected ecosystems that stretch across their legal boundaries. One of the most important early challenges faced by the Partnership was to develop a regional perspective, based on the best available information, of the conservation value of each individual ownership and all GCPEP lands and waters in total.

The GCPEP members asked The Nature Conservancy ("TNC") to develop a regional assessment of biodiversity that the GCPEP could use to shape their collective conservation strategies. The partners adopted a set of conservation targets (that is, species and natural communities that become the target of conservation effort), that were selected by consensus of the partners. An initial selection of eight conservation targets was increased to a final selection of 16 targets after review by the GCPEP staff and Steering Committee. The Nature Conservancy used a planning process termed *ecoregional planning* to determine which sites in the U.S. have the greatest conservation value (The Nature Conservancy 1996). The ecoregional planning process consists of 1) subdividing the U.S. into *ecoregions* based on Bailey (1995), 2) using the ecoregion as the basic planning unit, 3) reviewing all available information on the status of species, ecological groups and natural communities to choose *ecoregional conservation targets*[1],

---

[1] Ecoregional conservation targets consist of G1-G2, declining, imperiled, or keystone species and all representative natural communities or ecological groups. This methodology encompasses the so-called *fine filter-coarse filter*

4) setting numeric *ecoregional conservation goals*[2] for targets and 5) assessing all known occurrences of targets across the ecoregion to choose a suite of *conservation sites*[3] sufficient to meet the ecoregional target goals.

The GCPEP ownerships are located within the East Gulf Coastal Plain ecoregion (Fig. 1-1). The collective lands and waters contained within the Partnership (Fig. 1-2) were identified as one of the two most important conservation landscapes (e.g., large-scale sites) in the ecoregion based on the high concentration of target species, the landscape-level diversity of natural communities and the high quality of many of the occurrences (Table 1-1). A detailed summary of this information is found in Chapter 2.

Conservation planning at the site scale

Once a site is determined to be important from an ecoregional perspective, then the known conservation needs of the ecoregional targets (e.g., life history requirements for individual species or groups of species) that occur at the site can be used to determine site boundaries and local threats to long-term persistence. The Nature Conservancy terms this process *site conservation planning* (The Nature Conservancy 1998a). Site conservation planning is undertaken from the perspective of the species and natural community targets occurring at a given site. Site conservation planning has the following components: 1) identifying the ecoregional target species and natural communities that are present at a given site that serve as the *site conservation targets*; 2) assembling and assessing all available ecological information pertinent to the targets and the site; 3) assembling and assessing pertinent socioeconomic information (Chapter 3); and 4) using this information to assess the *threats*[4] to the targets at the site. An assessment of targets and threats is included in Chapter 4. Once agreement on the targets and threats has been reached, then conservation *strategies* and *measures of success* can be developed.

Conservation planning process

Within GCPEP, the conservation planning process has consisted of the following elements: 1) documentation of individual partner objectives; 2) identification of common challenges and conservation issues; 3) agreement on conservation targets; 4) identification and implementation of short-term joint projects; and 5) completion of two issues workshops (see below). The results of planning to-date are summarized in Chapter 5, 6, 7 and 8.

---

approach, where rare and imperiled species act as the fine filter and where natural communities or ecological groups act as the coarse filters to pick up common species and important ecological processes, interactions and gradients occurring at larger spatial scales and higher levels of biological organization.

[2] For example, a goal might be 15 populations of bird species X, each population with at least 200 breeding pairs.

[3] A site is a mappable, defined place in the ecoregion that is sufficiently large enough to protect viable populations of species targets and/or functional examples of natural communities or ecological groups.

[4] A threat is defined as a stress and its source. For example, large-scale habitat fragmentation causes demographic isolation in red-cockaded woodpecker's populations (stress) as a direct result of traditional even-aged forestry practices (source of stress).

Issue workshops: Red-cockaded woodpeckers and prescribed fire

One of the most important ecoregional and site target species is the red-cockaded woodpecker (*Picoides borealis*) (RCW). The RCW is a small cooperative breeding woodpecker inhabits fire-dependent old-growth pine forests of the Southeast. The RCW was one of the first species listed as endangered under the Endangered Species Act of 1973. The RCW has declined throughout its range primarily due to massive habitat loss. More recently, the RCW has become threatened by habitat degradation resulting from logging practices and fire suppression. In the GCPEP landscape, past logging practices have isolated many RCW breeding groups. While these destructive logging practices have largely been halted on partner lands, RCWs continue to decline. This issue was the topic of an issues workshop held at Eglin July 21–23, 1998 and is summarized in the attached report entitled "Adaptive management of red-cockaded woodpeckers in northwest Florida: Progress and perspectives" (Moranz and Hardesty 1998).

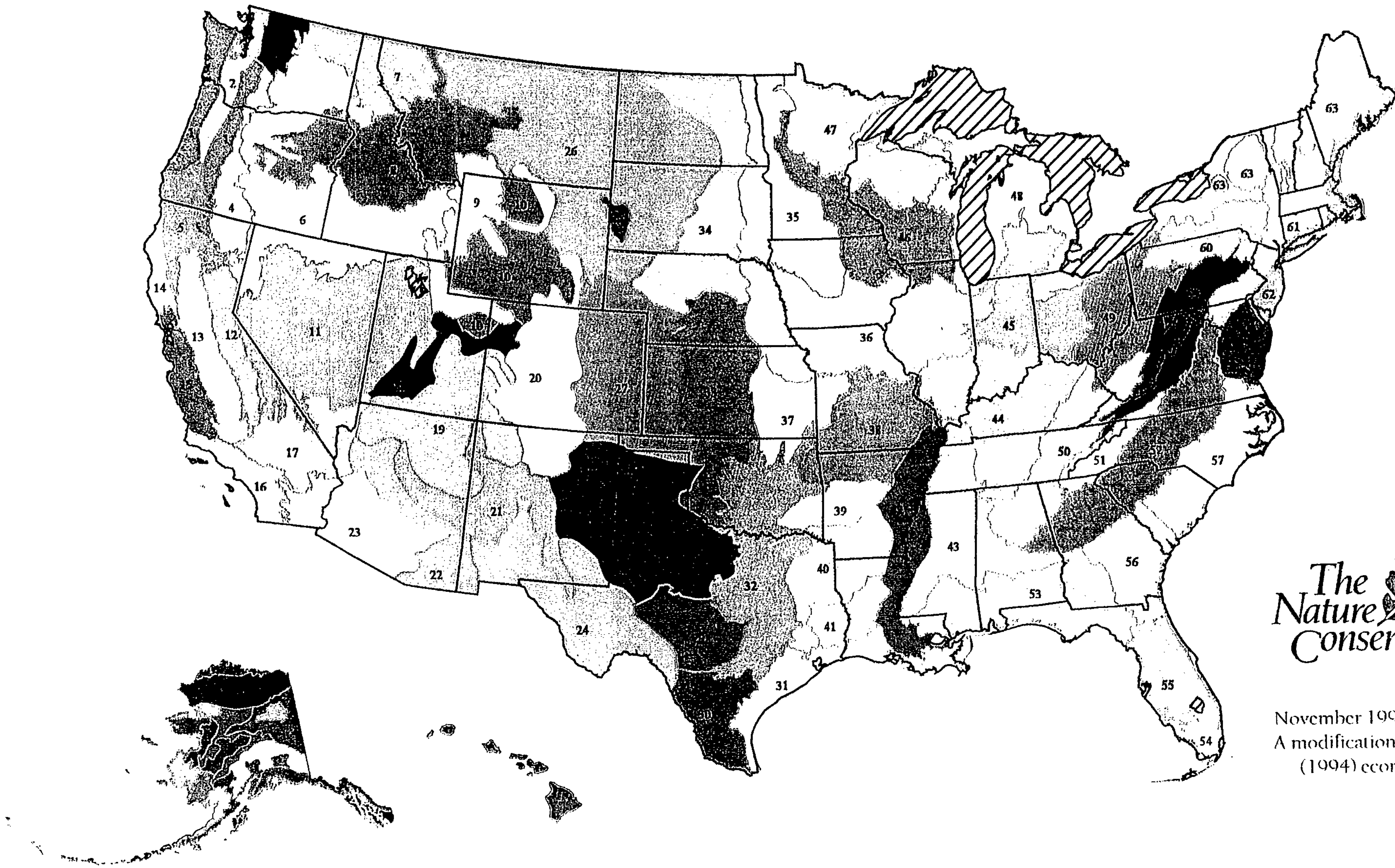
Fire is perhaps the single most important ecological process in longleaf pine-dominated uplands in the Southeast. Without fire, the many fire-adapted plant and animal species, and the longleaf pine itself, will decline. Because of past logging and fire management practices many longleaf pine-dominated GCPEP areas and embedded communities are considered degraded. Reintroduction of fire is not a simple task, nor is maintaining and staffing the necessary large-scale prescribed fire program. Prescribed fire was addressed in a number of workshops. Summaries, in the form of Powerpoint™ presentations developed at the request of managers, were submitted to Eglin and Blackwater River State Forest managers immediately following the most recent workshops on February 22–25, 1999.

TABLE 1-1. Summary of conservation value of lands and waters included in the Gulf Coastal Plain Ecosystem Partnership.

Conservation Value of GCPEP
• Despite being only 2% of the 42 million acre East Gulf Coastal Plain Ecoregion area, lands and waters included in the 840,000 acre Gulf Coastal Plain Ecosystem Partnership feature viable examples of 37% of 308 species targets and 38% of 297 natural community targets identified for the ecoregion as a whole • Protects >163 rare or imperiled plant, lichen, vertebrate and invertebrate species, including at least 40 G1-G2 species • Encompasses 20–25% of the world's remaining large tracts of longleaf pine, including the largest public ownerships and more than 50% of the remaining old growth stands • Features the highest quality barrier island complex on Florida's Gulf Coast • The Choctawhatchee, Escambia-Conecuh and Yellow River watersheds and estuaries were identified as critical U.S. watershed hotspots (The Nature Conservancy 1998b) including at least 59 globally rare or imperiled species, and the Escambia River contains the richest and most imperiled fish assemblage in Florida • Includes >900,000 acres of public land, including Eglin AFB (463K ac), Blackwater River State Forest (191K ac), Northwest Florida Water Management District (98K ac) and Conecuh National Forest (83K ac)

FIGURE 1-1. Ecoregions of the U.S. as defined by Bailey (1995) and The Nature Conservancy. The project is located in the East Gulf Coastal Plain (see #53 on following page).

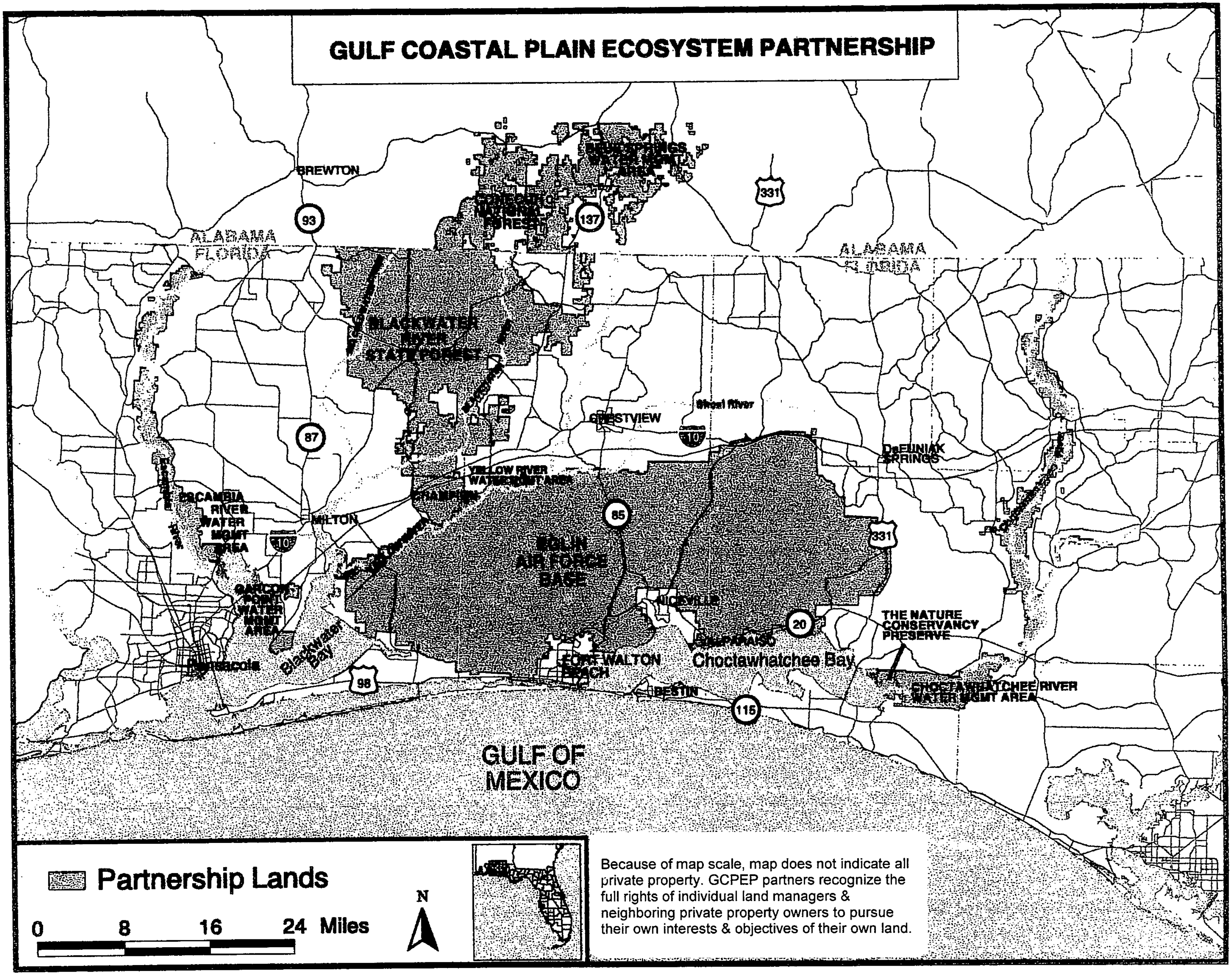
Ecoregions of the United States



The Nature Conservancy®

November 1996 version.
A modification of Bailey's
(1994) ecoregions.

FIGURE 1-2. Gulf Coastal Plain Ecosystem Partnership lands and surrounding landscape in the far western Florida Panhandle and southern Alabama, U.S.A. Lands marked in green are included in the seven member, public-private partnership that comprises nearly 840,000 acres.


GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP
BREWTON
ALABAMA
FLORIDA
BLACKWATER RIVER STATE FOREST
CRESTVIEW
Shoal River
DeFUNIAK SPRINGS
YELLOW RIVER WATER MGMT AREA
ESCAMBIA RIVER WATER MGMT AREA
MILTON
EGLIN AIR FORCE BASE
GARCON POINT WATER MGMT AREA
NICEVILLE
THE NATURE CONSERVANCY PRESERVE
Pensacola
Blackwater Bay
FORT WALTON BEACH
Choctawhatchee Bay
CHOCTAWHATCHEE RIVER WATER MGMT AREA
DESTIN
GULF OF MEXICO
Partnership Lands
0 8 16 24 Miles
N
Because of map scale, map does not indicate all private property. GCPEP partners recognize the full rights of individual land managers & neighboring private property owners to pursue their own interests & objectives of their own land.

CHAPTER 2. CONSERVATION FROM AN ECOREGIONAL PERSPECTIVE: THE BIODIVERSITY SIGNIFICANCE OF THE GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP

Report purpose

The purposes of this chapter are to provide:

- A summary of the overall significance of the 840,000 acre ownership of GCPEP in the context of the entire 42 million acre East Gulf Coastal Plain ecoregion;
- A list of suggested "conservation targets" (species only) that occur on GCPEP lands and waters that may benefit from individual and cooperative conservation efforts.

Ecoregional conservation & The Nature Conservancy

During the 1990s, The Nature Conservancy ("TNC") began planning and working at larger geographic scales to conserve biodiversity. Toward this end, The Nature Conservancy adopted an "ecoregional conservation approach" (The Nature Conservancy 1997). Ecoregions are land areas that are large enough to encompass processes and multiple occurrences of rare and imperiled species and natural communities, yet small enough within which to plan, identify partners and take action. The U.S. ecoregional classification adopted by TNC is a modification of that adopted by the U.S. Forest Service (Bailey 1995).

The Nature Conservancy's conservation goal in each U.S. ecoregion is to work with willing partners to conserve multiple examples of all native community types and all native species in functioning landscapes. The Nature Conservancy clearly recognizes, as does the GCPEP, that this ambitious conservation goal will be achieved only to the extent that it is able to engage public and private partners in successful conservation initiatives. "Partnership" means finding common ground, seeking socially acceptable and scientifically credible solutions, and respecting the sometimes very different missions and goals of partners, including private landowners.

Conservation targets: Species and natural communities

As a way of helping to focus the efforts of GCPEP, TNC staff and partners developed a list of "conservation targets" for the East Gulf Coastal Plain ecoregion consistent with the methods used in other ecoregional planning efforts. Defining conservation targets is a critical first step in identifying the sites, goals and projects necessary for successful biodiversity conservation.

Conservation targets include:

1. All native plant communities and identifiable ecological complexes;
2. Species that are globally rare, imperiled or declining across their range or in the ecoregion; and
3. Other species or ecological features of conservation interest (e.g., species requiring large areas, keystone species, important breeding aggregations, etc.).

This emphasis on conservation targets reflects the "coarse filter–fine filter" (communities as coarse filter–species as fine filters) approach adopted by TNC and scientists in an effort to ensure that all species, not just those singled out for conservation action, are conserved within functioning ecological complexes in the landscapes where they occur. The resulting targets are derived from all available sources of biodiversity information including data from the Natural Heritage Network, published records, museum records and consultation with biologists from public and private organizations and agencies. Development of conservation targets is considered by the Conservancy to be an iterative process and as new information is obtained, conservation targets and objectives will change.

Suggested species-level conservation targets for GCPEP

The East Gulf Coastal Plain ecoregion (EGCP) covers 42,439,000 acres, stretching from northeastern Louisiana across the southern portions of Mississippi, Alabama, Georgia and western Florida (Figure 1-1; ecoregion number 53). The exceptional biological diversity in this ecoregion ranks it among the two or three richest in North America. Unfortunately, historical and current rates of habitat loss and alteration also make its biological resources among the most threatened. At the scale of the East Gulf Coastal Plain ecoregion, TNC identified 310 target species (148 vascular plants, 1 lichen, 73 invertebrates, 28 fishes, 12 amphibians, 20 reptiles, 15 birds and 13 mammals) and 297 target natural communities that are considered to be rare, imperiled or of conservation concern (The Nature Conservancy 1999).

The Gulf Coastal Plain Ecosystem Partnership[5] (GCPEP) consists of seven public and private partners that manage land in the south-central portion of the East Gulf Coastal Plain (Figure 1-2). In this report, we present lists of EGCP target species that have been recorded on each of the partnership lands (Blackwater River State Forest, Conecuh National Forest, the Champion International Corporation connector parcel, Choctawhatchee River Delta Preserve, Choctawhatchee River Water Management Area, Eglin Air Force Base, Garcon Point Water Management Area, Lower Escambia River Water Management Area and Yellow River Water Management Area). Please note that this chapter focuses on species-level targets, and does not analyze or present findings on natural communities. Later chapters will examine natural communities.

This list of suggested conservation targets represents TNC's initial attempt to provide the GCPEP with a biodiversity perspective larger than any one ownership. The individual members of the GCPEP may have species-level targets that differ from the Conservancy's or none at all. These lists represent agreed upon conservation objectives for GCPEP. It is hoped that this list may help GCPEP members collectively and individually focus their limited conservation resources on the highest conservation priorities from an ecoregional, national and global perspective.

[5] In 1995, the GCPEP was formalized by means of a MOU signed by each of the following partners: Eglin Air Force Base (463,441 acres), Florida Division of Forestry (189,374 acres), Northwest Florida Water Management District (97,781 acres), National Forests in Alabama (83,790 acres), Champion International Corporation (7,550 acres), The Nature Conservancy (2,750 acres), and National Forests in Florida (1,114 acres).

Methods

To determine which EGCP target species have been recorded on each natural area managed by GCPEP, TNC staff and partners examined lists of rare and imperiled species recorded by the Florida Natural Areas Inventory, the Alabama Natural Heritage Program and TNC's East Gulf Coastal Plain Ecoregional Planning Team. Additional occurrence data were obtained from other private, state and federal cooperators. The completeness of these lists may be limited by several factors. Species distributions presented here may understate the real distribution; it is probable that some species have escaped detection, especially in areas where little sampling has been performed. Additionally, due to a backlog of work at the natural heritage agencies, some natural occurrences of target species that have been observed in the field have yet to be documented in the computerized databases that we used. In contrast, some species recorded in the GCPEP landscape may no longer occur on some ownerships. However limited, these lists represent the most comprehensive data available at this writing.

Summary of findings

Species-level targets. The GCPEP landscape is considered by The Nature Conservancy to be one of the two most important landscapes in the ecoregion and a critical link in conserving the biodiversity of the Southeastern U.S. While its area comprises less than 2% of the 47 million acre East Gulf Coastal Plain ecoregion, the GCPEP landscape includes 37% of the target species and 38% of the natural communities of the ecoregion. Of the 310 species of plants, animals and lichens that are considered EGCP target species by The Nature Conservancy, at least 115 have been recorded as occurring on GCPEP lands, including 51 vascular plants, one lichen, 26 invertebrates, 10 fishes, six amphibians, nine reptiles, five birds and seven mammals (Tables 2-1a,b,c). Eleven are listed as federally endangered or threatened, with many more that may be considered for future listing unless immediate conservation action is taken.

Tables 2.3–2.11 list the target species that are found at each managed area, including those that are unique or nearly unique to each. Many of the managed areas host endemic or near endemic species and communities, and thus have a unique role to play in conservation at landscape and ecoregional scales. Sixty-one of the target species occurring on GCPEP lands have Natural Heritage ranks of G1, G2, T1, or T2, meaning that they have extremely limited distributions from a global perspective. Forty-five do not occur outside of the East Gulf Coastal Plain ecoregion.

Of these, at least 20 occur only within the GCPEP managed areas, and nowhere else. For example, a small area overlapping Eglin Air Force Base and Champion International properties contains the entire known range of the Florida bog frog (*Rana okaloosae*), an endemic species and one of the rarest vertebrates in North America. Eglin is home to another endemic vertebrate, the Okaloosa darter (*Etheostoma okaloosae*). Blackwater River State Forest, Eglin and Choctawhatchee River Water Management Area all host endemic invertebrates. Global conservation of these species depends on conservation of their habitat on GCPEP managed areas.

The GCPEP lands include significant portions of the watersheds of the Escambia-Conecuh, Blackwater, Yellow-Shoal and Choctawhatchee rivers. A recent assessment of North American freshwater systems identified these four watersheds as important hotspots for protecting at-risk fish and mussels and critical for conserving freshwater biodiversity in the U.S

(The Nature Conservancy 1998). For example, of the nine freshwater mollusks target species found in GCPEP managed areas, eight are G1 or G2 species, and five are endemic to the watersheds of the GCPEP landscape. All five occur in the Choctawhatchee River; two of them (*Ptychobranchus jonesi* and *Quincuncuna burkei*) exclusively so, but three with disjunct distributions (*Pleurobema strodeanum* is also found within the Lower Escambia Water Management Area, while *Villosa australis* and *Villosa choctawensis* have also been found at Conecuh National Forest). There have been relatively few studies of these freshwater systems. Surveys currently underway are expected to reveal significant new findings, especially on the Alabama portions of each watershed.

The Gulf Coastal Plain Ecosystem Partnership also hosts numerous targets that are non-endemic yet of great conservation concern. Some of the more imperiled non-endemics include the federally endangered red-cockaded woodpecker (*Picoides borealis*), which occurs on three of the partner lands; the federally threatened gulf sturgeon (*Acipenser oxyrhinchus desotoi*), found in five rivers managed by GCPEP partners; and the white-top pitcherplant (*Sarracenia leucophylla*), which has been found at eight partner lands. The presence of these species on multiple partner landholdings, including in some cases the movement of individuals among them (e.g., red-cockaded woodpeckers), suggests that many opportunities for cooperative conservation exists among GCPEP land managers, and in some cases, may be essential for the long-term persistence of a number of important species.

<u>Natural community-level targets</u>. In all, at least 115 natural communities are represented on GCPEP lands, representing at least 38% of the 297 types described for the ecoregion. Gulf Coastal Plain Ecosystem Partnership ownerships comprise perhaps the most important and largest ownerships of the remaining vestiges of the once vast longleaf pine ecosystem, ranging from xeric sandhills to coastal flatwoods and including the largest remaining old growth stands. The former longleaf pine ecosystem has declined by as much as 98% across its former range. Gulf Coastal Plain Ecosystem Partnership lands and waters include perhaps as much as 20–25% of the remaining large ownerships. But the GCPEP landscape includes far more than just longleaf pine-dominated ecological complexes. For example, GCPEP ownerships include some of the largest remaining and best examples of barrier island-beach complexes on the U.S. Gulf coast, and some very rare plant associations, such as *Chrysoma/Conradina* dwarf-shrubland and *Hypericum chapmanii* dome swamp. The importance of these lands in protecting natural communities and ecological complexes will become better understood with further documentation.

TABLE 2-1a. ECGP Target plant and lichen species recorded on GCPEP lands. A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	Federal listing	Partner Lands
PLANTS				
Agalinis filicaulis	Jackson false foxglove	G3G4	N	EAFB
Aristida simpliciflora	southern three-awned grass	G2	N	EAFB
Arnoglossum diversifolium	variable-leaved indian plantain	G2	N	CRWMA, EAFB
Arnoglossum sulcatum	indian plantain	G3G4	N	CONNF, EAFB
Asclepias viridula	southern milkweed	G2	N	EAFB
Aster chapmanii	Shinner's aster	G2G3	N	EAFB
Aster eryngiifolius	coyote-thistle aster	G3?	N	CONNF, EAFB
Baptisia calycosa var *villosa**	hairy wild indigo	G2T1T2	N	EAFB, CHAMP
Calamintha dentata	toothed savory	G3	N	EAFB
Calamovilfa curtissii	Curtiss' sandgrass	G2	N	CHONF, EAFB, Garcon Point W.M.A,
Carex baltzellii	Baltzell's sedge	G2	N	EAFB
Chrysopsis godfreyi	Godfrey's golden aster	G2	N	EAFB
Chrysopsis gossypina cruiseana	Cruise's golden aster	G5T2	N	EAFB
Cladium mariscoides	pond rush	G5	N	EAFB, GPWMA
Coelorachis tuberculosa	piedmont jointgrass	G3	N	BRSF, EAFB
Eleocharis rostellata	beaked spikerush	G5	N	EAFB
*Helianthemum arenicola**	Gulf rockrose	G3	N	EAFB
*Hymenocallis henryae**	panhandle spiderlily	G1Q	N	EAFB
Juncus gymnocarpus	naked-fruited rush	G4	N	CONNF, EAFB
Lilium iridollae	panhandle lily	G1G2	N	BRSF, CHAMP, CONNF, EAFB, YRWMA
Lindera subcoriacea	bog spicebush	G2	N	EAFB, CONNF
Linum westii	West's flax	G2	N	EAFB
Ludwigia spathulata	spatulate seedbox	G2G3	N	CONNF
Lupinus westianus var *westianus**	Gulf Coast lupine	G2	N	EAFB, CHONF
Macranthera flammea	hummingbird flower	G3	N	BRSF, CONNF, EAFB
Magnolia ashei	Ashe's magnolia	G3	N	CRWMA, EAFB
Matelea alabamensis	Alabama spiny-pod	G1	N	EAFB

Scientific Name	Common Name	G-rank	Federal listing	Partner Lands
Monotropa hypopithys	pinesap	G5	N	EAFB
Nuphar lutea spp. *ulvacea*	west Florida cowlily	G5T2	N	CRWMA, EAFB, YRWMA
Panicum nudicaule	naked-stemmed panic grass	G3	N	CONNF, EAFB
Pinguicula planifolia	Chapman's butterwort	G3?	N	BRSF, CHONF, CONNF, EAFB, GPWMA, YRWMA
Pinguicula primuliflora	primrose-flowered butterwort	G3G4	N	EAFB, CONNF
Pityopsis oligantha	coastal-plain golden-aster	G1G3	N	CONNF, EAFB
Polygonella macrophylla	large-leaved jointweed	G2	N	CHONF, EAFB
Quercus arkansana	Arkansas oak	G3	N	CHONF, EAFB
Rhexia parviflora	small-flowered meadowbeauty	G2	N	BRSF, EAFB
Rhexia salicifolia	panhandle meadowbeauty	G2	N	CONNF, EAFB
Rhododendron austrinum	orange azalea	G3	N	CHONF, CRWMA, CONNF, EAFB
Rhynchospora crinipes	hairy-peduncled beakrush	G1	N	EAFB
Ruellia noctiflora	night-flowering ruellia	G2G3	N	CONNF
Sarracenia leucophylla	white-top pitcherplant	G3	N	BRSF, CHAMP, CHONF, CONNF, EAFB, GPWMA, YRWMA
Sarracenia purpurea	purple pitcherplant	G5	N	EAFB
Sarracenia rubra ssp wherryi	Wherry's sweet pitcher-plant	G3T3	N	CONNF, BRSF
Schwalbea americana	chaffseed	G2	LE	BRSF
Selaginella ludoviciana	Gulf spike moss	G3G4	N	EAFB
Sideroxylon thornei	Thorne's buckthorn	G2	N	EAFB
Tephrosia mohrii	pineland hoary-pea	G2?Q	N	EAFB
Verbesina chapmanii	Chapman's crownbeard	G2G3	N	EAFB
Xyris chapmanii	Chapman's yellow-eyed grass	G3	N	BRSF, CONNF
*Xyris isoetifolia**	quillwort yellow-eyed grass	G2?	N	CONNF
Xyris longisepala	Kral's yellow-eyed-grass	G2	N	CONNF
LICHENS				
*Cladonia perforata**	perforate reindeer lichen	G1	LE	EAFB

PARTNER LAND ABBREVIATIONS EXPLAINED:

BRSF = Blackwater River State Forest
CHAMP = Champion International Corporation Connector Parcel
CONNF = Conecuh National Forest
CRWMA = Choctawhatchee River Water Management Area
CHONF = Choctawhatchee National Forest
CRDP = Choctawhatchee River Delta Preserve
EAFB = Eglin Air Force Base
GPWMA = Garcon Point Water Management Area
LERWMA = Lower Escambia River Water Management Area
YRWMA = Yellow River Water Management Area

TABLE 2-1b. ECGP Target invertebrate species recorded on GCPEP lands. A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	Federal Listing	Partner Lands
INSECTS				
*Agarodes ziczac***	Zigzag Blackwater River caddisfly	G1	N	BRSF
*Baetisca escambiensis***	a mayfly	G1	N	BRSF
Cernotina truncona	Florida cernotinan caddisfly	G4G5	N	CONNF
*Cheumatopsyche gordonae***	Gordon's little sister sedge (a caddisfly)	G1	N	EAFB
*Cheumatopsyche petersi***	Peter's little sister sedge (a caddisfly)	G1	N	EAFB
Cordulegaster sayi	Say's spiketail	G1G2	N	BRSF, CONNF
Gomphus westfalli	diminutive clubtail	G1G2	N	BRSF
*Hydroptila latosa***	broad varicolored microcaddisfly	G1	N	EAFB
*Ochrotrichia okaloosa***	Okaloosa somber microcaddisfly	G1	N	EAFB
*Oxyethira kelleyi***	Kelley's cream brown microcaddisfly	G1	N	EAFB
*Polyamina pubescens***	panhandle beach scarab	G2	N	EAFB
MOLLUSKS				
*Elimia clenchi***	Clench's goniobasis	G1G2	N	CRWMA
Elliptio mcmichaeli	fluted elephantear	G3Q	N	CRWMA
Fusconaia escambia	narrow pigtoe	G2	N	LERWMA
Lampsilis ornata	southern pocketbook	G1?	N	LERWMA
Lampsilis straminea claibornensis	southern fatmucket	G5T5	N	CONNF
Lepidostoma morsei	Morse's little plain brown sedge	G1	N	EAFB
Margaratifera marrianae	Alabama pearlshell	G1	N	CONNF
Oecetis morsei	a caddisfly	G1	N	CONNF
Pleurobema strodeanum	fuzzy pigtoe	G2	N	CRWMA, LERWMA
Polycentropus floridensis	Florida brown checkered summer sedge	G2	N	EAFB
Ptychobranchus jonesi	southern kidney shell	G2	N	CRWMA, CONNF
*Quincuncina burkei**	tapered pigtoe	G2	N	CRWMA
Strophitus subvexus	southern creekshell	G3	N	CONNF
*Villosa australis**	southern sandshell	G2	N	CONNF, CRWMA
*Villosa choctawensis**	choctaw bean	G2	N	CONNF, CRWMA

TABLE 2-1c. ECGP Target vertebrate species recorded on GCPEP lands. A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	**Common Name**	**G-rank**	**FED listing**	**Partner Lands**
FISHES				
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T2	LT	CONNF, CRWMA, CRDP, EAFB, LERWMA, YRWMA
Alosa alabamae	Alabama shad	G4	N	CRWMA, LEWMA, YRWMA
Etheostoma bifascia	Florida sand darter	G3	N	CONNF
Etheostoma davisoni	Choctawhatchee darter	G3	N	CONNF
*Etheostoma okaloosae***	Okaloosa darter	G2	LE	EAFB
Etheostoma prolieare	cypress darter	G5	N	LERWMA
Fundulus escambiae	russetfin topminnow	G4	N	CONNF
Fundulus jenkinsi	saltmarsh topminnow	G3	N	GPWMA
Macrhybopsis sp. 2	Florida chub	G3	N	CRWMA, LERWMA
Percina austroperca	southern logperch	G3	N	LERWMA
AMPHIBIANS				
Ambystoma cingulatum	flatwoods salamander	G2G3	LT	EAFB, CHAMP, CONNF
Ambystoma tigrinum	tiger salamander	G5	N	BRSF
Amphiuma pholeter	one-toed amphiuma	G3	N	EAFB
Hyla andersonii	pine barrens treefrog	G4	N	BRSF, CONNF, EAFB
Rana capito sevosa	dusky gopher frog	G4T2	N	BRSF, CONNF, EAFB
Rana okaloosae	Florida bog frog	G2	N	CHAMP, EAFB
REPTILES				
Caretta caretta	loggerhead sea turtle	G3	LT	EAFB
Chelonia mydas	green sea turtle	G3	LE	EAFB
Crotalus adamanteus	eastern diamondback rattlesnake	G5	N	BRSF, CRWMA, EAFB, CONNF
Drymarchon corais couperi	eastern indigo snake	G4T3	LT	BRSF, EAFB, CONNF
Gopherus polyphemus	gopher tortoise	G3	LT	BRSF, CONNF, EAFB
Graptemys ernsti	Escambia map turtle	G2	N	EAFB, LERWMA, YRWMA

Scientific Name	Common Name	G-rank	FED listing	Partner Lands
Heterodon simus	southern hognose snake	G2	N	CONNF, EAFB
Macroclemys temminckii	alligator snapping turtle	G3G4	N	BRSF, CRWMA, CONNF, EAFB, LERWMA, YRWMA
Pituophis melanoleucus mugitus	Florida pine snake	G5T3?	N	BRSF, CHAMP, CONNF, EAFB
BIRDS				
Aimophila aestivalis	Bachman's sparrow	G3	N	EAFB, CONNF, BRSF
Charadrius alexandrinus	snowy plover	G4	N	EAFB
Falco sparverius paulus	southeastern American kestrel	G5T3T4	N	EAFB
Picoides borealis	red-cockaded woodpecker	G3	LE	BRSF, CONNF, EAFB
*Speotyto cunicularia floridana**	Florida burrowing owl	G4T3	N	EAFB
MAMMALS				
Corynorhinus rafinesquii	Rafinesque's Big-eared bat	G3G4	N	CONNF
Myotis austroriparius	southeastern myotis	G3G4	N	CONNF
Neofiber allenii	round-tailed muskrat	G3	N	EAFB
*Peromyscus polionotus leucocephalus**	Santa Rosa beach mouse	G5T1	N	EAFB
Peromyscus polionotus peninsularis	St. Andrews beach mouse	G5T1	N	EAFB
Trichechus manatus	manatee	G2?	LE	CRDP, CRWMA, EAFB, GPWMA, YRWMA
Ursus americanus floridanus	Florida black bear	G5T2	N	CHAMP, CONNF, EAFB

TABLE 2-2. ECGP Target species recorded at Blackwater River State Forest, Florida (as of April 1999). A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
PLANTS							
Coelorachis tuberculosa	piedmont jointgrass	G3	N	S3	N	2	FNAI, 1999
Lilium iridollae	panhandle lily	G1G2	N	S1S2	LE	3	FNAI, 1999
Macranthera flammea	hummingbird flower	G3	N	S2	LE	4	FNAI, 1999
Pinguicula planifolia	Chapman's butterwort	G3?	N	S2	LE	2	FNAI, 1999
Rhexia parviflora	small-flowered meadowbeauty	G2	N	S2	LE	2	FNAI, 1999
Sarracenia leucophylla	white-top pitcherplant	G3	N	S3	LE	38	FNAI, 1999
Sarracenia rubra spp. wherryi	Wherry's sweet pitcher plant	G3T3	?	?	?	?	Compton, pers. comm
Schwalbea americana	chaffseed	G2	LE	S1	LE	1	Obersholster, pers. comm.
Xyris chapmanii	Chapman's yellow-eyed grass	G3	N	S1	N	1	FNAI, 1999
INSECTS							
*Agarodes ziczac***	zigzag Blackwater River caddisfly	G1	N	S?	N	?	Deyrup and Franz, 1994
Baetisca escambiensis	a mayfly	G1G2	N	S?	N		EGCP Team, 1999
Cordulegaster sayi	Say's spiketail	G1G2	N	S1S2	N	1	FNAI, 1999
Gomphus westfalli	diminutive clubtail	G1G2	N	S?	N	?	Deyrup & Franz, 1994
AMPHIBIANS							
Ambystoma tigrinum	tiger salamander	G5	N	S3	N	3	FNAI, 1999
Hyla andersonii	pine barrens treefrog	G4	N	S3	LS	31	FNAI, 1999
Rana capito sevosa	dusky gopher frog	G3	N	S3	LS	2	FNAI, 1999
BIRDS							
Aimophila aestivalis	Bachman's sparrow	G3	N	S3	N	?	Sheehan

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
Picoides borealis	red-cockaded Woodpecker	G3	LE	S2	LT	20	FNAI, 1999
REPTILES							
Crotalus adamanteus	eastern diamondback rattlesnake	G5	N	S3	N	2	FNAI, 1999
Drymarchon corais couperi	eastern indigo snake	G4T3	LT	S3	LT	2	FNAI, 1999
Gopherus polyphemus	gopher tortoise	G3	LT	S3	LS	10	FNAI, 1999
Macroclemys temminckii	alligator snapping turtle	G3G4	N	S3	LS	1	FNAI, 1999
Pituophis melanoleucus mugitus	Florida pine snake	G5T3?	N	S3	LS	2	FNAI, 1999

TABLE 2-3. ECGP Target species recorded at the Champion International connector parcel, Florida (as of April 1999). A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
PLANTS							
Baptisia calycosa var *villosa**	hairy wild indigo	G2T3	N	S3	LT	2	FNAI, 1999
Lilium iridollae	panhandle lily	G1G2	N	S1S2	LE	1	FNAI, 1999
Sarracenia leucophylla	white-top pitcherplant	G3	N	S3	LE	1	FNAI, 1999
AMPHIBIANS							
Ambystoma cingulatum	flatwoods salamander	G2G3	LT	S2S3	N	1	FNAI, 1999
*Rana okaloosae**	Florida bog frog	G2	N	S2	LS	2	FNAI, 1999
REPTILES							
Pituophis melanoleucus mugitus	Florida pine snake	G5T3?	N	S3	LS	1	FNAI, 1999
MAMMALS							
Ursus americanus floridanus	Florida black bear	G5T2	N	S2	LT	?	LAAC and FNAI, 1992.

TABLE 2-4. EGCP Target species recorded at Choctawhatchee National Forest, Florida (as of April 1999). A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
PLANTS							
Calamovilfa curtissii	Curtiss' sandgrass	G2	N	S3	LT	1	FNAI, 1999
Lupinus westianus var *westianus**	Gulf Coast lupine	G2	N	S2	LT	1	FNAI, 1999
Pinguicula planifolia	Chapman's butterwort	G3?	N	S2	LT	1	FNAI, 1999
Polygonella macrophylla	large-leaved jointweed	G2	N	S2	LT	3	FNAI, 1999
Quercus arkansana	Arkansas oak	G3	N	S3	N	2	FNAI, 1999
Rhododendron austrinum	orange azalea	G3G4	N	S3	LE	1	FNAI, 1999
Sarracenia leucophylla	white-top pitcherplant	G3	N	S3	LE	2	FNAI, 1999

TABLE 2-5. EGCP Target species recorded at TNC's Choctawhatchee River Delta Preserve, Florida (as of April 1999)

Scientific Name	**Common Name**	**G-rank**	**FED Status**	**FNAI State Rank**	**State Status**	**# FNAI Recorded Locations**	**References**
FISHES							
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T2	LT	S2	LS	1	FNAI, 1999
MAMMALS							
Trichechus manatus	manatee	G2	LE	S2	LE	1	FNAI, 1999

TABLE 2-6. ECGP Target species recorded at the Choctawhatchee River Water Management Area, Florida (as of April 1999). A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	References
PLANTS							
Arnoglossum diversifolium	variable-leaved indian plantain	G2	N	S2	LT	2	FNAI, 1999
Magnolia ashei	Ashe's magnolia	G3	N	S2	LE	4	FNAI, 1999
Nuphar lutea spp. *ulvacea*	west Florida cowlily	G5T2	N	S2	N	1	FNAI, 1999
Rhododendron austrinum	orange azalea	G3G4	N	S3	LE	2	FNAI, 1999
BIVALVE MOLLUSKS							
*Elimia clenchi***	Clench's goniobasis	G1G2	N	S1	N	7	FNAI, 1999
Elliptio mcmichaeli	fluted elephantear	G3Q	N	S1S2	N	9	FNAI, 1999
Pleurobema strodeanum	fuzzy pigtoe	G2	N	S?	N	1	FNAI, 1999
Ptychobranchus jonesi	southern kidney shell	G2	N	S1	N	3	FNAI, 1999
*Quincuncina burkei***	tapered pigtoe	G2	N	S?	N	5	FNAI, 1999
*Villosa australis**	southern sandshell	G2	N	S?	N	1	FNAI, 1999
*Villosa choctawensis**	choctaw bean	G2	N	S1	N	7	FNAI, 1999
FISHES							
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T2	LT	S?	LS	1	FNAI, 1999
Alosa alabamae	Alabama shad	G4	N	S?	N	1	EGCP Team, 1999
Macrhybopsis sp. 2	Florida chub	G3	N	S2	N	2	FNAI, 1999
REPTILES							
Crotalus adamanteus	eastern diamondback rattlesnake	G5	N	S3	N	1	FNAI, 1999
Macroclemys temminckii	alligator snapping turtle	G3G4	N	S3	LS	1	FNAI, 1999
MAMMALS							
Trichechus manatus	manatee	G2?	LE	S2?	LE	1	FNAI, 1999

TABLE 2-7. EGCP Target species recorded at Conecuh National Forest, Alabama (as of April 1999). A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	FED Status	State Rank	State Status	# FNAI Recorded Locations	Reference
PLANTS							
Arnoglossum sulcatum	indian plantain	G3G4	N	S2S3	N	6	ALNHP, 1999
Aster eryngiifolius	coyote-thistle aster	G3?	N	S2	N	1	ALNHP, 1999
Juncus gymnocarpus	naked-fruited rush	G4	N	S1	N	2	ALNHP, 1999
Lilium iridollae	panhandle lily	G1G2	N	S1	N	4	ALNHP, 1999
Lindera subcoriacea	bog spicebush	G2	N	S1	N	2	ALNHP, 1999
Ludwigia spathulata	spatulate seedbox	G2G3	N	S1S2	N	1	ALNHP, 1999
Macranthera flammea	flame flower	G3	N	S2S3	N	4	ALNHP, 1999
Panicum nudicaule	naked-stemmed panic grass	G3	N	S2	N	8	ALNHP, 1999
Pinguicula planifolia	Chapman's butterwort	G3?	N	S1S2	N	?	CONNF, 1999
Pinguicula primulflora	primrose-flowered butterwort	G3G4	N	S3S4	N	1	ALNHP, 1999
Pityopsis oligantha	coastal-plain golden aster	G2G4	N	S?	N	7	ALNHP, 1999
Rhexia salicifolia	panhandle meadowbeauty	G2	N	S1	N	2	ALNHP, 1999
Rhododendron austrinum	orange azalea	G3	N	S2S3	N	4	ALNHP, 1999
Ruellia noctiflora	night-flowering ruellia	G2	N	S1	N	5	ALNHP, 1999
Sarracenia leucophylla	whitetop pitcher-plant	G3	N	S3	N	11	ALNHP, 1999
Sarracenia rubra ssp wherryi	Wherry's sweet pitcher-plant	G3T3		S3	N	1	ALNHP, 1999
Xyris chapmanii	Chapman's yellow-eyed grass	G3	N	S?	N	3	ALNHP, 1999
*Xyris isoetifolia**	quillwort yellow-eyed grass	G2?	N	SR	N	?	CONNF, 1999
Xyris longisepala	Kral's yellow-eyed-grass	G2	N	S1	N	2	ALNHP, 1999
BIVALVES							
Lampsilis straminea claibornensis	southern fatmucket	G5T5	N	S3	N	3	ALNHP, 1999
Margaratifera marrianae	Alabama pearlshell	G1	N	S1S2	N	5	ALNHP, 1999
Ptychobranchus jonesi	southern kidneyshell	G2	N	S2	N	?	CONNF, 1999
Strophitus subvexus	southern creekshell	G3	N	S1	N	1	ALNHP, 1999
Villosa australis	Southern sandshell	G2	N	S1S2	N	2	ALNHP, 1999
Villosa choctawensis	Choctaw bean	G2	N	S2	N	2	ALNHP, 1999

Scientific Name	Common Name	G-rank	FED Status	State Rank	State Status	# FNAI Recorded Locations	Reference
INSECTS							
Cernotina truncona	Florida cernotinan caddisfly	G4G5	N	S1	N	1	ALNHP, 1999
Cordulegaster sayi	Say's spiketail	G1G2	N	S?	N	?	CONNF, 1999
FISHES							
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T2	N	S1	N	1	ALNHP, 1999
Alosa alabamae	Alabama shad	G4	N	S2	N	1	ALNHP, 1999
Etheostoma bifascia	Florida sand darter	G3	N	S3	N	1	ALNHP, 1999
Etheostoma davisoni	Choctawhatchee darter	G3	N	S3	N	1	ALNHP, 1999
Fundulus escambiae	russetfin topminnow	G4	N	S3	N	1	ALNHP, 1999
AMPHIBIANS							
Ambystoma cingulatum	flatwoods salamander	G2G3	LT	S1	SP	???	CONNF, 1999
Hyla andersonii	pine barrens treefrog	G4	N	S2	SP	11	ALNHP, 1999
Rana capito sevosa	dusky gopher frog	G4T2	N	S2	SP	3	ALNHP, 1999
BIRDS							
Aimophila aestivalis	Bachman's sparrow	G3	N	S3	N		CONNF, 1999
Picoides borealis	red-cockaded woodpecker	G3	LE	S2	SP	1	ALNHP, 1999
REPTILES							
Crotalus adamanteus	diamondback rattlesnake	G4	N	S3	N	?	CONNF, 1999
Drymarchon corais couperi	eastern indigo snake	G4T3	LT	S1	SP	?	CONNF, 1999
Gopherus polyphemus	gopher tortoise	G3	LT	S2	SP	?	CONNF, 1999
Graptemys ernsti	Escambia map turtle	G2	N	S2	N	2	ALNHP, 1999
Heterodon simus	southern hognose snake	G2	N	SH	SP	2	ALNHP, 1999
Macroclemys temminckii	alligator snapping turtle	G3G4	N	S3	SP	1	ALNHP, 1999
Pituophis melanoleucus mugitus	Florida pine snake	G5T3?	N	S2	SP	3	ALNHP, 1999
MAMMALS							
Corynorhinus rafinesquii	Rafinesque's big-eared bat	G3G4	N	S2	SP	?	CONNF, 1999
Myotis austroriparius	southeastern myotis	G3G4	N	S2	SP	1	ALNHP, 1999

Scientific Name	Common Name	G-rank	FED Status	State Rank	State Status	# FNAI Recorded Locations	Reference
Ursus americanus floridanus	Florida black bear	G5T2	N	S2	N	1	ALNHP, 1999

TABLE 2-8. EGCP Target species recorded at Eglin Air Force Base (as of April 1999). A single asterisk follows names of species that are endemic to the GCPEP landscape, while two asterisks follow those endemic to a single GCPEP site.

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
PLANTS							
Agalinis filicaulis	Jackson false foxglove	G3G4	N	S3	N	?	EGCP Team, 1999
Arnoglossum diversifolium	variable-leaved indian plantain	G2	N	S2	LT	?	Kindell et al., 1997
Arnoglossum sulcatum	indian plantain	G3G4	N	S?	N	?	EGCP Team, 1999
Aristida simpliciflora	southern three-awned grass	G2	N	S2	N	2	FNAI, 1999
Asclepias viridula	southern milkweed	G2	N	S2	LT	2	FNAI, 1999
Aster chapmanii	Shinner's aster	G2G3	N	S2S3	?	2	FNAI, 1999
Aster eryngiifolius	snakeroot	G3?	N	S2S3	?	15	FNAI, 1999
Baptisia calycosa var *villosa**	hairy wild indigo	G2T3	N	S1S2	LT	195	FNAI, 1999
Calamintha dentata	toothed savory	G3	N	S3	N	14	FNAI, 1999
Calamovilfa curtissii	Curtiss' sandgrass	G2	N	S3	LT	61	FNAI, 1999
Carex baltzellii	Baltzell's sedge	G2	N	S2	LT	90	FNAI, 1999
Chrysopsis godfreyi	Godfrey's golden aster	G2	N	S2	N	11	FNAI, 1999
Chrysopsis gossypina cruiseana	Cruise's golden aster	G5T2	N	S2	LE	33	FNAI, 1999
Cladium mariscoides	pond rush	G5	N	S1	N	3	FNAI, 1999
Coelorachis tuberculosa	piedmont jointgrass	G3	N	S3	N	5	FNAI, 1999
Eleocharis rostellata	beaked spikerush	G5	N	S1	LE	1	FNAI, 1999
*Helianthemum arenicola**	Gulf rockrose	G3	N	S3	?	19	FNAI, 1999
*Hymenocallis henryae**	panhandle spiderlily	G1Q	N	S1	LE	1	FNAI, 1999
Juncus gymnocarpus	naked-fruited rush	G4	N	S1	N	3	FNAI, 1999
Lilium iridollae	panhandle lily	G1G2	N	S1S2	LE	39	FNAI, 1999
Lindera subcoriacea	bog spicebush	G2	N	S1	LE	3	FNAI, 1999
Linum westii	West's flax	G2	N	S2	LE	2	FNAI, 1999
Lupinus westianus var *westianus**	Gulf Coast lupine	G2	N	S2	LT	1	FNAI, 1999
Macranthera flammea	hummingbird flower	G3	N	S2	LE	5	FNAI, 1999
Magnolia ashei	Ashe's magnolia	G3	N	S2	LE	31	FNAI, 1999
Matelea alabamensis	Alabama spiny-pod	G1	N	S1	LE	20	FNAI, 1999
Monotropa hypopithys	pinesap	G5	N	S1	LE	3	FNAI, 1999

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
Nuphar lutea ssp *ulvacea*	west Florida cowlily	G5T2	N	S2	N	26	FNAI, 1999
Panicum nudicaule	naked-stemmed panic grass	G3?	N	S2?	N	69	FNAI, 1999
Pinguicula planifolia	Chapman's butterwort	G3?	N	S2	LT	53	FNAI, 1999
Pinguicula primuliflora	primrose-flowered butterwort	G3G4	N	S3	LE	2	FNAI, 1999
Pityopsis oligantha	coastal plain golden aster	G1G3	N	S?	N	?	Kindell et al., 1997
Polygonella macrophylla	large-leaved jointweed	G2	N	S2	LT	23	FNAI, 1999
Quercus arkansana	Arkansas oak	G3	N	S3	N	144	FNAI, 1999
Rhexia parviflora	small-flowered meadowbeauty	G2	N	S2	LE	10	FNAI, 1999
Rhexia salicifolia	panhandle meadowbeauty	G2	N	S2	N	23	FNAI, 1999
Rhododendron austrinum	orange azalea	G3G4	N	S3	LE	23	FNAI, 1999
Rhynchospora crinipes	hairy-peduncled beakrush	G1	N	S1	N	12	FNAI, 1999
Sarracenia leucophylla	white-top pitcherplant	G3	N	S3	LE	131	FNAI, 1999
Sarracenia purpurea	purple pitcherplant	G5	N	S3	LT	2	FNAI, 1999
Selaginella ludoviciana	Gulf spike moss	G3G4	N	S?	N	?	EGCP Team, 1999
Sideroxylon thornei	Thorne's buckthorn	G2	N	S1	LE	1	FNAI, 1999
Tephrosia mohrii	pineland hoary-pea	G2?Q	N	S1	N	160	FNAI, 1999
Verbesina chapmanii	Chapman's crownbeard	G2G3	N	S2S3	LT	209	EGCP Team, 1999
Xyris longisepala	karst pond xyris	G2	N	S2	LE	15	FNAI, 1999
LICHEN							
*Cladonia perforata**	perforate reindeer lichen	G1	LE	S1	LE	7	FNAI, 1999
INSECTS							
*Cheumatopsyche gordonae***	Gordon's little sister sedge	G1	N	S?	N	?	Deyrup and Franz, 1994
*Cheumatopsyche petersi***	Peter's little sister sedge	G2	N	S1	N	?	Flowers, 1997
*Hydroptila latosa***	broad varicolored microcaddisfly	G1	N	S?	N	?	Deyrup and Franz, 1994
*Lepidostoma morse**i*	Morse's little plain brown sedge	G1	N	S?	N	?	EGCP Team, 1999

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
*Ochrotrichia okaloosa***	Okaloosa somber microcaddisfly	G1	N	S?	N	?	Deyrup and Franz, 1994
Oecietis morsei	a caddisfly	G1	N	S?	N	?	EGCP Team, 1999
*Oxyrethira kelleyi***	Kelly's cream and brown microcaddisfly	G1	N	S?	N	?	Deyrup and Franz, 1994
Polycentropus floridensis	Florida brown checkered summer sedge	G2	N	S?	N	?	EGCP Team, 1999
*Polylamina pubescens***	panhandle beach scarab	G2	N	S?	N	?	Flowers, 1997
FISHES							
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T2	LT	S2	LS	2	FNAI, 1999
*Etheostoma okaloosae***	Okaloosa darter	G2	LE	S2	LE	6	FNAI, 1999
AMPHIBIANS							
Ambystoma cingulatum	flatwoods salamander	G2G3	LT	S2S3	N	3	FNAI, 1999
Amphiuma pholeter	one-toed amphiuma	G3	N	S3	N	3	FNAI, 1999
Hyla andersonii	pine barrens treefrog	G4	N	S3	LS	53	FNAI, 1999
Rana capito sevosa	dusky gopher frog	G3	N	S3	LS	13	FNAI, 1999
*Rana okaloosae**	Florida bog frog	G2	N	S2	LS	17	FNAI, 1999
REPTILES							
Caretta caretta	loggerhead	G3	LT	S3	LT	1	FNAI, 1999
Chelonia mydas	green turtle	G3	LT	S2	LE	1	FNAI, 1999
Crotalus adamanteus	eastern diamondback rattlesnake	G5	N	S3	N	24	FNAI, 1999
Drymarchon corais couperi	eastern indigo snake	G4T3	LT	S3	LT	16	FNAI, 1999
Gopherus polyphemus	gopher tortoise	G3	LT	S3	LS	26	FNAI, 1999
Graptemys ernsti	Escambia map turtle	G2	N	S2	N	1	FNAI, 1999
Heterodon simus	southern hognose snake	G2	N	S?	N	4	FNAI, 1999
Macroclemys temminckii	alligator snapping turtle	G3G4	N	S3	LS	3	FNAI, 1999
Pituophis melanoleucus mugitus	Florida pine snake	G5T3?	N	S3	LS	14	FNAI, 1999

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
BIRDS							
Aimophila aestivalis	Bachman's sparrow	G3	N	S3	N	10	FNAI, 1999
Charadrius alexandrinus	snowy plover	G4	N	S2	LT	1	FNAI, 1999
Falco sparverius paulus	southeastern American kestrel	G5T3T4	N	S3?	LT	3	FNAI, 1999
Picoides borealis	red-cockaded woodpecker	G3	LE	S2	LT	22	FNAI, 1999
Speotyto cunicularia floridana	Florida burrowing owl	G4T3	N	S3	LS	3	FNAI, 1999
MAMMALS							
Neofiber allenii	round-tailed muskrat	G3	N	S3	N	27	EGCP Team, 1999
*Peromyscus polionotus leucocephalus**	Santa Rosa beach mouse	G5T1	N	S1	N	2	FNAI, 1999
Peromyscus polionotus peninsularis	St. Andrews beach mouse	G5T1	N	S1	LE	?	FNAI, 1999
Trichechus manatus	manatee	G2?	LE	S2?	LE	1	FNAI, 1999
Ursus americanus floridanus	Florida black bear	G5T2	N	S2	LT	2	FNAI, 1999

TABLE 2-9. EGCP Target species recorded at Garcon Point Water Management Area, Florida (as of April 1999)

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	State Status	# FNAI Recorded Locations	Reference
PLANTS							
Calamovilfa curtissii	Curtiss's sandgrass	G2	N	S2	LE	5	FNAI, 1999
Cladium mariscoides	pond rush	G5	N	S1	N	1	FNAI, 1999
Pinguicula planifolia	Chapman's butterwort	G3?	N	S2	LE	2	FNAI, 1999
Sarracenia leucophylla	white-top pitcher plant	G3	N	S3	LE	2	FNAI, 1999
FISHES							
Fundulus jenkinsi	saltmarsh topminnow	G3	N	S2	LS	1	FNAI, 1999
MAMMALS							
Trichechus manatus	manatee	G2?	LE	S2?	LE	1	FNAI, 1999

TABLE 2-10. EGCP Target species recorded at Lower Escambia Water Management Area (as of April 1999)

Scientific Name	Common Name	G-rank	FED Status	FNAI State Rank	# FNAI Recorded Locations	Reference
BIVALVE MOLLUSKS						
Fusconaia escambia	narrow pigtoe	G2	N	S?	4	FNAI, 1999
Lampsilis ornata	southern pocketbook	G1?	N	S1	2	FNAI, 1999
Pleurobema strodeanum	fuzzy pigtoe	G2	N	S?	1	FNAI, 1999
FISHES						
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T2	LT	S?	1	FNAI, 1999
Alosa alabamae	Alabama shad	G4	N	S?	1	EGCP Team, 1999
Etheostoma proeliare	cypress darter	G5	N	S2	4	FNAI, 1999
Macrhybopsis sp. 2	Florida chub	G3	N	S2	3	FNAI, 1999
Percina austroperca	southern logperch	G3	N	S2	1	FNAI, 1999
REPTILES						
Graptemys ernsti	Escambia map turtle	G2	N	S2	1	FNAI, 1999
Macroclemys temminckii	alligator snapping turtle	G3G4	N	S3	1	FNAI, 1999

TABLE 2-11. EGCP Target species recorded at Yellow River Water Management Area, Florida (as of April 1999)

Scientific Name	**Common Name**	**G-rank**	**FED Status**	**FNAI State Rank**	**State Status**	**# FNAI Recorded Locations**	**Reference**
PLANTS							
Lilium iridollae	panhandle lily	G1G2	N	S1S2	LE	1	FNAI, 1999
Nuphar lutea spp. *ulvacea*	west Florida cowlily	G5T2	N	S2	N	2	FNAI, 1999
Pinguicula planifolia	Chapman's butterwort	G3?	N	S2	LT	1	FNAI, 1999
Sarracenia leucophylla	white-top pitcherplant	G3	N	S3	LE	1	FNAI, 1999
FISHES							
Acipenser oxyrinchus desotoi	Gulf sturgeon	G3T1T3	LE	S?	LE	1	FNAI, 1999
Alosa alabamae	Alabama Shad	G4	N	S?	N	0	EGCP Team, 1999
REPTILES							
Graptemys ernsti	Escambia map turtle	G2	N	S2	N	1	FNAI, 1999
Macroclemys temminckii	alligator snapping turtle	G3G4	N	S3	LS	1	FNAI, 1999
MAMMALS							
Trichechus manatus	manatee	G2?	LE	S2?	LE	1	FNAI, 1999

Explanation of global and state ranks

Explanations and definitions of FNAI global rank, FNAI state rank, federal status and state status (taken from Marois, 1998, with the permission of the author). The Nature Conservancy and the Natural Heritage Program network (of which FNAI is a part) define an *element* as any exemplary or rare component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave or other ecological feature. An *element occurrence* (EO) is a single extant habitat that sustains or otherwise contributes to the survival of a population or a distinct, self-sustaining example of a particular element.

Using a ranking system developed by The Nature Conservancy and the Natural Heritage Program Network, the Florida Natural Areas Inventory assigns two ranks to each element. The *global rank* is based on an element's worldwide status; the *state rank* is based on the status of the element in Florida. Element ranks are based on many factors, the most important ones being estimated number of Element occurrences, estimated abundance (number of individuals for species; area for natural communities), range, estimated adequately protected EOs, relative threat of destruction, and ecological fragility.

Federal and State Status information is from the following sources:

- Federal animals and plants - U.S. Fish and Wildlife Service, October 31,1997, *Endangered and Threatened Wildlife and Plants*, 50 CFR 17.11 and 17.12,
- State animals - Florida Game and Fresh Water Fish Commission, August 1, 1997, *Florida's Endangered Species and Species of Special Concern, Official Lists*
- State plants - Coile, N. C. 1998. Notes on the Florida's Regulated Plant Index, Rule 5B-40. Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, FL.

FNAI global rank definitions

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
G2 = Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
G3 = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.
G4 = Apparently secure globally (may be rare in parts of range)
G5 = Demonstrably secure globally
GH= Of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)
GX= Believed to be extinct throughout range
GXC = Extirpated from the wild but still known from captivity or cultivation
G#? = Tentative rank (e.g., G2?)

G#G# = Range of rank; insufficient data to assign specific global rank (e.g., G2G3)
G#T# = Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1)
G#Q = Rank of questionable species - ranked as species but questionable whether it is species or subspecies; numbers have same definition as above (e.g., G2Q)
G#T#Q= Same as above, but validity as subspecies or variety is questioned.
GU= Due to lack of information, no rank or range can be assigned (e.g., GUT2).
G? = Not yet ranked (temporary)

FNAI state rank definitions

S1 = Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
S2 = Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
S3 = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.
S4 = Apparently secure in Florida (may be rare in parts of range)
S5 = Demonstrably secure in Florida
SH = Of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker)
SX = Believed to be extinct throughout range
SA = Accidental in Florida, i.e., not part of the established biota
SE = An exotic species established in Florida may be native elsewhere in North America
SN = Regularly occurring, but widely and unreliably distributed; sites for conservation hard to determine

Federal legal status (Listed by the U. S. Fish and Wildlife Service - USFWS)

LE = Listed as Endangered Species in the List of Endangered and Threatened Wildlife and Plants under the provisions of the Endangered Species Act. Defined as any species which is in danger of extinction throughout all or a significant portion of its range.
PE = Proposed for addition to the List of Endangered and Threatened Wildlife and Plants as Endangered Species.
LT = Listed as Threatened Species. Defined as any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
PT = Proposed for listing as Threatened Species.
C = Candidate Species for addition to the list of Endangered and Threatened Wildlife and Plants. Defined as those species for which the USFWS currently has on

file sufficient information on biological vulnerability and threats to support proposing to list the species as endangered or threatened.

E(S/A) = Endangered due to similarity of appearance.

T(S/A) = Threatened due to similarity of appearance.

N = Not currently listed, nor currently being considered for addition to the List of endangered and Threatened Wildlife and Plants.

State Legal Status

- *Animals* (Listed by the Florida Game and Fresh Water Fish Commission - FGFWFC)

  LE = Listed as Endangered Species by the FGFWFC. Defined as a species, subspecies, or isolated population which is so rare or depleted in number or so restricted in range of habitat due to any man-made or natural factors that it is in immediate danger of extinction or extirpation from the state, or which may attain such a status within the immediate future.

  LT = Listed as Threatened Species by the FGFWFC. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.

  LS = Listed as Species of Special Concern by the FGFWFC. Defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species.

  N = Not currently listed, nor currently being considered for listing.

- *Plants* (Listed by the Florida Department of Agriculture and Consumer Services - FDACS)

  LE = Listed as Endangered Plants in the Preservation of Native Flora of Florida Act. Defined as species of plants native to the state that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue, and includes all species determined to be endangered or threatened pursuant to the Federal Endangered Species Act of 1973, as amended.

  LT = Listed as Threatened Plants in the Preservation of Native Flora of Florida Act. Defined as species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in such number as to cause them to be endangered.

  N = Not currently listed, nor currently being considered for listing.

- *Special animal listings - state and federal status*

    - *Grus americana* (whooping crane) - Federally listed as XN (nonessential experimental population) which refers to the Florida experimental population only; Federal listing elsewhere is LE.

    - *Pandion haliaetus* (osprey) - State listed as LS (Species of Special Concern) in Monroe county only; not listed in rest of state.

    - *Mustela vison mink* pop (southern mink, S. Florida population) - State listed as LT (Threatened) which refers to the Everglades population only; species formerly listed as *Mustela vison evergladensis*.

    - *Ursus americanus floridanus (Florida black bear)* - State listed as LT but not applicable in Baker and Columbia counties or the Apalachicola National Forest.

CHAPTER 3. SOCIOECONOMIC ASSESSMENT OF THE GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP LANDSCAPE

Introduction

The partner institutions of the Gulf Coastal Plain Ecosystem Partnership ("GCPEP") are responsible for the management of 840,000 acres in western Florida and southern Alabama. Approximately 97% of this acreage occurs in three Alabama counties (Conecuh, Covington and Escambia) and four Florida counties (Escambia, Okaloosa, Santa Rosa and Walton). A socioeconomic analysis of this seven-county region was performed by reviewing statistical abstracts, public documents and internet sites that provide socioeconomic data. Socioeconomic conditions of the region as a whole, and also important intra-regional differences, are discussed in the following summary.

Major differences among counties and groups of counties exist. Knowledge of differences and similarities among counties will:

- Assist the GCPEP in understanding the socioeconomic forces shaping the region;
- Offer insight into future trends;
- Identify viable opportunities for cooperation among cities, towns and local governments, as well as identify divisive issues.

Regional analysis

Population & demographics. Between 1990 and 1997, the population of this seven county region increased by 88,519 or 14.7%; a rate greater than 1980s growth (U.S. Bureau of the Census 1998). Population growth occurred primarily in the four Florida counties. The populations of Santa Rosa, Walton and Okaloosa counties grew at faster rates than the state and the nation during those years. Santa Rosa and Walton counties were two of the fastest growing counties in the nation, with growth rates of 40.3 % and 36.6%, respectively. Escambia County, FL grew by 7.5%, slower than the state of Florida rate of 13.3%, and experienced a negative net migration. Populations of the region's three Alabama counties grew much more slowly than Alabama as a whole and the nation.

During the 1990s, people moved into the region at an unprecedented rate. Nearly half of the population growth (47%) in this region between 1990 and 1995 was due to immigration. However, Conecuh County, AL and Escambia County, FL actually experienced negative net migrations during those years (U.S. Bureau of the Census 1997).

Ethnic background of the region's residents in 1990 was 82% white, 15% African-American, 1.8% Hispanic, and smaller percentages for Native Americans/Eskimos/Aleutians, and Asians/Pacific Islanders. These data are virtually unchanged from those of 1980, and fairly closely match national figures, except for the small percentage of persons of Hispanic origin.

Land use. The seven county region consists mainly of forested land. In 1995, 72% of the 2.4 million acres of the four Florida counties were classified as timberland and 1% were woodland (forest too low in quality for economical production). Although increasing human population in the area sometimes leads to reduction of forested land, the amount of timberland in

the Florida sub-region increased by 2% between 1987 and 1995 (Brown 1988, 1996). The most recent publications show that the Alabama sub-region had similar percentages of timberland (Vissage & Miller 1991) as of 1990. Patterns of ownership differed between the Alabama and Florida counties as of 1990. Forestry corporations own 45% of the timber in the Alabama counties, but only 25% in the Florida counties (Vissage & Miller 1991).

Farmland in the region, comprising 15% of the land, is being converted to other uses at a high rate. Between 1978 and 1992, the number of farms and farm acreage decreased by 25% and 29%, respectively (U.S. Bureau of Census 1996)

In the four Florida counties, the rate of residential development increased greatly between the late 1980s and the mid-1990s. For example, 377 housing units were constructed in Escambia County, FL in 1989 and 1990, while 3391 were constructed there in 1994 and 1995, a nine-fold increase. Okaloosa, Santa Rosa, and Walton counties all experienced two-fold increases in annual housing unit construction over the same period (Bureau of Economic and Business Research 1991, 1997). With this increase in construction, there has been a large increase in the acreage of residential land (from 9.38% of land area to 12.06%). For example, between 1990 and 1998, Santa Rosa County experienced a 28% increase in residential property, so that by 1998, 12% of the county's land was residential. Other land uses showing increases were commercial acreage (14% increase) and industrial acreage (11% increase), while the acreage of vacant lands and agricultural property have decreased (Santa Rosa County Community Planning 1998).

The rate of residential development in the three Alabama counties was slow as of the mid-1990s (Center for Business and Economic Research 1997). In 1994 and 1995, permits were issued for the construction of 126 new residential buildings, with 234 housing units, in all three Alabama counties combined. This figure is small compared to the permits issued for 15,000 units in the four Florida counties during those years.

Employment & economic performance. The counties of western Florida have had a very robust job market during the last two decades:

- The employed labor force increased by 66,000 between 1980 and 1990, and job growth occurred in every major employment sector except mining (U.S. Bureau of the Census 1996).
- Rapid growth in the number of jobs has continued in the 1990s. The county with the greatest increase was Okaloosa, with a 19.4% increase between 1992 and 1998 (Haas Center for Business Research and Economic Development 1999).
- The unemployment rate declined from 6.7% in 1990, to 5.2% in 1994, to 4.8% in 1998, and to less than 4% in March 1999 (Haas Center for Business Research and Economic Development 1999).
- The unemployment rate in the Florida counties has been consistently lower than state and national averages between 1991 and 1999 (U.S. Bureau of Labor Statistics 1999).

Employment problems do exist in the Florida sub-region. Industrial sector, moderate-income jobs are fewer in western Florida relative to the rest of Florida and the nation. The number of industrial jobs has declined in this region faster than the rate for the nation and is below the national figure. Many of the newly created jobs are low paying, which has long been

characteristic of jobs in these counties (as well as for the Alabama counties) (Hawkins and Kastro 1999). Significant job growth did not occur in the three Alabama counties between 1980 and 1990 (U.S. Bureau of the Census 1996). Slight growth has occurred during the 1990s, and March 1999 unemployment rates in these counties were down to ~6.5% (Bureau of Labor Statistics 1999).

The three most important employment sectors in the region as of 1990 were technical, sales and administrative support (31%), wholesale/retail trade (23%), manufacturing (13%) and the military (9%) (U.S. Bureau of the Census 1996). The military is an extremely important employer in Florida's three westernmost counties, the economies of which would be seriously hurt by substantial military downsizing in the area. The military is not a major source of employment in Walton County, Florida or in the three Alabama counties.

Only 2.3% of the employed civilian labor force worked in agriculture, forestry or fisheries in 1990. This percentage is relatively unchanged since 1980 (2.4%). Four employment sectors that grew especially quickly during the 1980s and 1990s were technical, sales and administrative support (nearly 25,000 jobs), wholesale/retail trade (17,000 jobs), tourism and construction (5,000 jobs) (U.S. Bureau of the Census 1996; Haas Center for Business Research and Economic Development 1999).

The tourism industry in the four Florida counties is extremely important and continues to grow, as indicated by a 4.9% increase in bed tax revenues over last year. The funds from the bed tax revenues are used for local development projects, thereby benefiting the tourism industry (CBRED 1999). An increase in bridge traffic to the beaches of nearly 10% over last year also points to a rise in tourism. Tourism is a relative non-factor in the three Alabama counties.

As of 1993, per capita incomes in the Alabama counties and Walton County, Florida was low (approximately $14,000) compared to average per capita income for Alabama, Florida and the nation. Per capita incomes in Escambia, Santa Rosa and Okaloosa counties in Florida ($16,899, $16,556 and $18,202, respectively) were substantially higher than those in the three Alabama counties and Walton Co., FL, but were lower than the average figures for Alabama, Florida and the nation.

Compared to national standards, cost of living is relatively low, in large part due to inexpensive housing (Haas Center for Business Research and Economic Development 1999). Although incomes are about 20% lower than the national average, prices of housing and commodities are only slightly lower in the western Florida counties than in the nation as a whole. (Hawkins and Kastro 1999). Recent data on cost of living in the Alabama counties was not available.

Social conditions. In 1995, 57.6% of Alabama county residents were high school graduates and 8.1% were college graduates. In 1989 the poverty rate was 26%, having increased from 22% in 1979. In 1995, 78% of Florida county residents were high school graduates and 18.7% were college graduates. In 1989, the poverty rate was 15%, having increased from 16% in 1979 (U.S. Bureau of the Census 1997).

Significant economic differences were present in the region in 1990. The year 2000 Census is likely to show evidence of the same conditions. The poverty rate for

African- Americans is 39.7% and 12.0% for whites. The poverty rate for children, at 23.5%, is higher than that for adults (U.S. Bureau of the Census 1997).

Citizen conservation attitudes. Data regarding the attitudes of the citizens of this region toward conservation issues is scarce. However, one indicator is the voting record for the citizens of the four Florida counties on Constitutional Revision No. 5 (Conservation of Natural Resources and Creation of Fish and Wildlife Conservation Commission). Seventy-two (72%) percent of the voters in Florida voted in favor of Revision No. 5. The percent of voters in the four Florida counties in this region that voted to pass it was lower, but still constituted a majority in three of the counties. In Escambia 62.2% voted yes, in Santa Rosa 57.1%, in Okaloosa 50.9% and in Walton only 47.3% voted yes.

Intra-county variation. Land-use and socioeconomic patterns vary among and within counties in the region. The Florida counties of the GCPEP region have local variation that is likely to have consequences for implementation of conservation and planning efforts. The southern portions of the four Florida counties are coastal or near the coast. The population and economic power of coastal Florida is much greater than that of the rural northern portions, leading to differences in personal income, unemployment rate (Hawkins and Kastro 1999) and property values. Such differences have led to strife in county commission politics, and may hinder community planning and conservation efforts at the county level.

Summary of findings

Between 1990-1997, the seven county area in Florida and Alabama increased by nearly 15%. The majority of the growth occurred in the four Florida counties. Santa Rosa (40.3%) and Okaloosa (36.6%) were among the fastest growing counties in the country, while the three Alabama counties experienced little growth. Most of the growth (nearly half) was due to immigration. The region is predominately white (82%), but Escambia and Conecuh counties in Alabama have large black populations (28.1% and 42.2%, respectively).

Timberland is the predominant land use (72%) and between 1987 and 1995, timberland remained relatively stable, increasing by 2%. Forestry corporations own 45% of the timber in the Alabama counties, but only 25% in the Florida counties. Farmland, decreased by 29% during the same period. Much of this decrease was due to residential development, especially in the fast growing Okaloosa, Santa Rosa and Walton counties of Florida. By 1998, 12% of the land area was classified as residential. Alabama counties showed relatively slow residential growth during a similar period.

Employment and job growth increased significantly in the Florida counties during the 1980s and 1990s, with job growth particularly strong in the technical, sales, administrative support, wholesale/retail trade and manufacturing. The majority of the new jobs are in the low paying service sector. Alabama experienced job growth, but at slower rates. In all cases, unemployment rates have generally declined over the past five to eight years (<4% in Florida and ~6.5% in Alabama). Employment in tourism is a growing and important economic force in the Florida counties, owing to their outstanding coastal beaches and bays.

Living expenses in the region were lower than the national average, but so was per capita income. Per capita incomes were substantially higher in Florida than in Alabama, with the three westernmost Florida counties having significantly higher average incomes.

CHAPTER 4. SUSTAINING BIODIVERSITY AT SITES

Site conservation planning

Developing a readily accessible, reasonably fast and cost-effective means of conservation planning focused on conserving biological diversity at particular sites has proven to be an elusive goal for scientists and land managers. Conservation planning has to overcome many challenges, not the least of which is the need or desire to simultaneously accommodate many different, often competing goals, only one of which may be conserving biodiversity. The Nature Conservancy has developed a relatively simple, iterative and biodiversity-centered approach termed *site conservation planning* (The Nature Conservancy 1998a, 1998c). The goal of site conservation planning is to develop a set of workable conservation strategies that will allow the biological targets of conservation to persist over the long-term with as little input from humans as possible. In order for this to happen, the landscapes (of various scales) within which the species and ecosystems of concern exist, have to be protected or managed in a way that is hospitable to long-term persistence, while allowing for change and random perturbations.

This approach explicitly recognizes that ecosystems are complex moving targets, that ecosystem structure and composition are controlled by processes operating at many different spatiotemporal scales simultaneously, and that biologists have little understanding of the structure and function or life history needs of most of the ecosystems and species that they seek to conserve. Thus, all knowledge is treated as provisional, and the planning *process* becomes as important as the *information* used in planning.

Biological diversity and functional landscapes

Biodiversity is often defined as simply the number of species occupying a given area (e.g., species richness). However, this definition vastly oversimplifies nature. Scientists now recognize that biodiversity exists at several levels of biological organization. These levels are typically defined as genes, species/populations, communities/ecosystems, landscapes and more recently, also include the dynamic, multi-scale processes that sustain structure and function (reviewed in Poiani et al. 2000). Although all levels are important, The Nature Conservancy focuses planning efforts at the population/species (hereafter "species") and community/ecosystem (hereafter "community") levels, primarily because this choice offers a relatively unambiguous starting point and some hope that success can be evaluated over time. We term these choices *site conservation targets*, which are a subset of the *ecoregional targets,* that occur in a given geographic area or site discussed in Chapter 2. In the GCPEP region, 115 species-level and 115 community-level ecoregional targets were identified.

Ecosystems, and to some extent, natural communities, can be defined as "…dynamic assemblages or complexes of plant and/or animal species… that (1) occur together on the landscape; (2) are tied together by similar ecological processes…, underlying environmental features…, or environmental gradients…, and (3) form a cohesive and distinguishable unit on the ground" (Poiani et al. 2000). Similarly, ecosystems also occur at a variety of spatial and temporal scales, from very localized occurrences (e.g., a rare plant occurring on an unusual geographic formation) to regional ecosystems stretching over tens of millions of acres (e.g., longleaf pine-

dominated plant communities). Combining biological levels *and* spatial scales provides a relatively simple and useful framework for thinking about conservation planning (Figure 4-1).

In addition to the choice of species and communities as the focus of conservation efforts, TNC also currently defines four overlapping geographic scales—*local, intermediate, coarse and regional*—to be used in defining functional conservation areas capable of sustaining biodiversity over the long-term (Figure 4-1). For example, a viable population of 200 adult black bears will require an area of several million acres in northwest Florida, encompassing many different natural community types, large relatively undisturbed areas, and with abundant safe movement corridors between home ranges. Black bears would be termed a "coarse scale species" because home ranges typically include several different vegetation communities or patches throughout the year, including agricultural areas. A "local scale species" would be a rare plant that inhabits only a certain limited soil type. Similarly, developing definitions of vegetation communities as "small patch" (local) "large patch" (intermediate) or "matrix" (coarse or regional) is very useful in determining conservation goals for plant communities at the landscape-scale (Figure 4-1).

A landscape capable of conserving the targets over time is termed *functional* if it meets two key criteria (Poiani et al. 2000);

1) Conserves clearly defined site conservation targets (species and communities);
2) Protects the multi-scale ecological processes that sustain the conservation targets over time.

Further, functional landscapes have several important characteristics: 1) their size, shape or other characteristics are defined by the needs of selected conservation targets at a given site; 2) key natural processes and appropriate structure exist within natural ranges of variation as defined by what is required to sustain the conservation targets over long time horizons (>100 years); 3) conflicts over human uses are inevitable; and 4) ecological management and restoration likely will be required at all scales (Poiani et al. 2000). An important consequence of this approach is that the boundaries of a given conservation landscape will vary with the ecological needs of different targets; any one landscape can consist of a number of different sized and shaped "sites" nested within the larger landscape. Thus, the choice of targets will define the threats to the targets, the site boundaries, and in large part, the choice of conservation partners.

Choosing site planning targets

Once conservation targets have been chosen for a site through ecoregional planning (Chapter 2) then managers should choose for planning purposes a smaller subset of the targets that occur at a site. As stated previously, both ecoregional and site targets are defined as 1) populations of species and 2) definable and mappable natural communities or 3) some other ecological unit (e.g., ecological complex, species guilds, etc.). Nature Conservancy practitioners refer to these as *site planning targets.* Attempting to use all *conservation* targets for planning purposes is often impossible because many species-level targets have little known life histories and/or because in large sites with many targets, analysis would be too unwieldy or complex. At the site level, appropriate choice of planning targets is the single most important step. All other conservation-related analyses and resulting management strategies are directed at abating the threats to persistence of these planning targets, and indirectly, the entire suite of conservation targets.

The goal is to choose a set of conservation targets that represent multiple levels of biological organization, have different life history requirements, depend on different ecological processes and encompass a variety of different spatial scales. In effect, planning targets act as conservation umbrellas or surrogates, however imperfectly, for all other similar target species and natural communities occurring in the geographic area. Thus, planning targets, whether community or species-level, are used to cumulatively address the ecological requirements for all species and communities occurring at a site.

Multiple species targets may be grouped together by functional guilds (e.g., shorebirds) or a single keystone species may act as a surrogate for a host of functionally related species (e.g., gopher tortoises as surrogates for all species using gopher tortoise burrows). At a higher level, groups of communities that occur together can be grouped as ecological complexes (e.g., coastal swale and ridge communities), or where one community type forms the dominant vegetation type in the landscape, within which many other communities and species are embedded, then matrix communities or mosaics can be defined (e.g., longleaf pine-turkey oak-bluestem matrix).

Defining site planning targets for GCPEP

Specific site planning targets for GCPEP were derived from a set of simple analyses that examined the distribution of the 115 species-level ecoregional targets across the GCPEP landscape. In all, 16 primary planning targets have been identified to date (Table 4-1). This list may change, as new information becomes available. For example, the choice of "seepage stream/slope complex" was based on an analysis of the distribution of approximately 65 rare plant and animal species occurrences on Eglin, the majority of which cluster around the steephead creek (seepage creek) complexes. Expert opinion suggested that protection of the seepage stream complexes would protect the conservation targets, including the associated slope forests and aquatic communities. Thus, conservation strategies will center on restoration of linear fragmentation, repair of road crossings, and restoration of ecological gradients. Fire will be used to establish and maintain ecotones.

Stresses and sources of stress to planning targets

Once planning targets have been identified, then *threats* can be articulated (Table 4-2). Threats are anything that compromises the long-term viability of the target at the site. A threat is defined as a *stress* and its *source*. For example, large-scale habitat fragmentation causes demographic isolation in red-cockaded woodpeckers' populations (a stress) as a direct result of traditional even-aged forestry practices applied at the landscape-scale (a source of stress).

The combination of targets, goals and threats define the boundaries of the site. For example, black bears probably occur on all individual ownerships within GCPEP, but a viable population (estimated at 200 bears) requires all of the GCPEP ownerships collectively, plus adjacent private lands not included in GCPEP. Table 4-3 combines targets and threats (in this case, sources of stress) by site. Rankings in all of the following tables are based on expert opinions about the relative severity and immediacy of the threat to the target and act as a filter for prioritizing key threats for the purpose of developing *conservation strategies*. (For an explanation of ranking criteria, see Tables 4-4 and 4-5.) Conservation strategies are designed to abate threats to conservation targets at sites and are addressed initially in Chapter 6. In the tables that follow,

we identify particular GCPEP sites, the planning targets and an assessment of the stresses and sources of stress to targets at sites.

Summary of findings

Of the 115 species-level ecoregional targets that occur in the GCPEP landscape, seven (red-cockaded woodpeckers, black bears, flatwood salamanders, Okaloosa darter, Florida bog frog, Gulf sturgeon, game birds) were chosen as planning targets. These seven species-level targets were chosen because they are declining across their range, each of them has large area requirements (relative to their body sizes), they are found on the majority of GCPEP acres and/or they would not necessarily be well protected through habitat management alone. Of the 115 GCPEP community/ecosystem-level targets, nine matrix-forming community types were chosen (longleaf pine sandhill matrix, longleaf pine flatwoods matrix, seepage stream/slope complex, blackwater rivers/streams, alluvial rivers/streams, barrier island complex, estuarine systems, depression marshes, sand pine scrub) as planning targets. Each of these matrix community types protects many rare, threatened and endangered species. The assumption is that if these systems are managed within appropriate ranges of variation, allowing or mimicking natural disturbance processes and restoring structure and function where seriously impaired, then the majority of species-level targets would be protected.

Overall, the most significant threats (as defined by sources of stress in this case) to non-riverine/estuarine targets were incompatible adjacent development, incompatible fire management, roads, and incompatible forestry practices, followed by unstable/inadequate funding, groundwater pumping, invasive species, and recreation. The most significant threats to riverine/estuarine targets were incompatible residential, industrial and municipal development, roads, culverts and bridges, incompatible agricultural practices, recreation, and inadequate/unstable funding.

TABLE 4-1. Conservation planning targets at Gulf Coastal Plain Ecosystem Partnership sites.

Conservation Planning Targets	**Site**
Longleaf pine sandhill matrix	Eglin, Champion, Blackwater, NW FL Water Management District
Longleaf pine flatwoods/uplands matrix	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District
Sand pine scrub	Eglin
Barrier island complex	Eglin
Depression marsh	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District, TNC
Seepage stream/slope complex	Eglin, Champion, Blackwater
Blackwater rivers/streams	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District
Alluvial rivers/streams	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District, TNC
Estuarine systems	Eglin, NW FL Water Management District, TNC
Red-cockaded woodpecker	Eglin, Blackwater, Conecuh
Florida black bear	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District, TNC
Upland game birds	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District
Flatwoods salamander	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District
Florida bog frog	Eglin, Champion
Okaloosa darter	Eglin
Gulf sturgeon	Eglin, Champion, Blackwater, Conecuh, NW FL Water Management District, TNC

TABLE 4-2. Stresses and sources of stress to targets at sites within the Gulf Coastal Plain Ecosystem Partnership.

SITE: Eglin Air Force Base and buffer lands

Name of Target: Longleaf pine sandhill and flatwood/upland matrix and associated communities-Eglin

Description: At 463,000 acres, Eglin Air Force Base is the largest and least fragmented, single longleaf pine ownership in the region of interest, and as such, is treated as a separate site. However, a number of Eglin conservation targets also occur on adjacent lands (e.g., Florida black bear). Eglin contains approximately 350,000 acres of longleaf pine sandhill, about 50% of which is considered to be in good or excellent condition. Eglin has the largest remaining stands of old-growth longleaf pine in existence. Upland-related conservation, planning and management targets on Eglin include the longleaf pine community matrix (sandhills, flatwoods, scrubby flatwoods, upland hardwood forest, upland mixed forest, sand pine scrub) described here, as well as seepage stream complexes, Florida black bears, red-cockaded woodpeckers and flatwoods salamanders (see below). An additional 85 ecoregional conservation targets occur on the site. Historically, longleaf pine was the dominant tree species on any site exposed to frequent, low intensity lightning or human-caused (interval of 2–7 years). Longleaf ecosystems have a simple structure comprised of open stands of large longleaf, few midstory hardwoods, and a diverse understory dominated by fire adapted forbs and grasses, especially bluestems. In addition to fire, major disturbance processes include lightning, occasional stand-replacing fires, droughts (once a decade on average), hurricanes or tropical storms (every 2–3 years on average), tornadoes, microbursts associated with convection storms, and intensive, small-scale, animal-caused soil disturbance. The greater longleaf pine ecosystem has declined by more than 95% across it range in the Southeast. Major sources of decline have been conversion, development, over-harvest and fire suppression.

Stresses: Longleaf pine sandhill & flatwood/upland matrix and associated communities-Eglin

Stress	Stress Rank
Sand pine invasion	H
Hardwood encroachment	M
Habitat conversion	H
Soil disturbance	L
Loss of biological buffers	H
Habitat fragmentation	M

Sources of Stress: Longleaf pine sandhill and flatwood/upland matrix and associated communities-Eglin

	Stresses						Overall Threat Rank
Sources of Stress	Sand pine invasion	Hardwood encroachment	Soil disturbance	Loss of biological buffers	Habitat conversion	Habitat fragmentation	
Incompatible forestry practices (Eglin/buffer)	**M**	**M**	**M**	**M**	**L**	**L**	**M**
Primary home development (buffer)		**H**		**VH**	**VH**	**VH**	**VH**
Military mission activities	**M**	**M**	**L**		**M**	**L**	**M**
Roads and utility corridors (Eglin/buffer)	**H**	**M**			**H**	**H**	**H**
Unstable funding	**H**	**M**					**H**
Smoke containment (Eglin/buffer)	**M**	**H**	**L**	**M**			**M**

SITE: Blackwater River State Forest, Conecuh National Forest, Champion International, Eglin Air Force Base, Northwest Florida Water Management District

Name of Target: Longleaf pine sandhill and flatwood/upland matrix and associated communities

Description: Same as for Eglin Air Force Base above, except that this landscape has highly fragmented public-private ownership; 286,000 acres of public lands are interdigitated by non-industrial and industrial timber holdings, small towns, housing developments, second homes, rural homesteads, pasture, cotton and tobacco fields, all of various sizes and shapes. Also, the longleaf pine dominated matrix is comprised primarily of flatwoods, scrubby flatwoods, mixed upland forest and mixed hardwood forest. While the longleaf community matrix is the primary conservation, planning and management target, at least 50 ecoregional targets also occur here.

Stresses: Longleaf pine sandhill and flatwood/upland matrix and associated communities

Stress	**Stress Rank**
Hardwood encroachment	**H**
Habitat conversion	**H**
Soil disturbance	**H**
Loss of biological buffers	**H**
Habitat fragmentation	**VH**
Herbicides	**H**

Sources of Stress: Longleaf pine sandhill and flatwood/upland matrix and associated communities

	Stresses						Overall Threat Rank
Sources of Stress	Hardwood encroachment	Habitat conversion	Soil disturbance	Loss of biological buffers	Habitat fragmentation	Herbicides	
Incompatible forestry practices (buffer)	**M**	**H**	**H**	**L**		**H**	**H**
Development/roads/utility corridors (sites & buffers)	**VH**	**VH**		**VH**	**VH**		**VH**
Public attitudes	**H**		**H**				**H**
Unstable funding	**VH**		**H**				**VH**
Off-road vehicle use			**H**				**H**
Smoke management	**H**		**H**	**H**			**H**

SITE: Eglin Air Force Base and buffer lands
Name of Target: Sand pine scrub
Description: Sand pine scrub communities have a overstory of sand pine and thickets of scrub oaks and other shrubs in the understory. Ground cover is generally dominated by ground lichens. This community occurs on sand ridges along former shorelines. These sands drain rapidly and the plants that live on them appear to have evolved water conservation strategies. Sand pine scrub is found close to the coast, usually located between the coast and the pine flatwoods where it is better sheltered from salt spray and heavy winds. Hot, fast burning fires naturally run through sand pine scrub every 20 to 80 years, burning catastrophically.

Stresses: Sand pine scrub

Stress	**Stress Rank**
Soil disturbance	**H**
Habitat succession	**M**
Habitat conversion	**H**

Sources of Stress: Sand pine scrub

Sources of Stress	Stresses			Overall Threat Rank
	Soil disturbance	Habitat succession	Habitat conversion	
Incompatible fire management		**H**		**H**
Vehicular traffic	**M**			**M**
Foot traffic	**M**			**M**
Incompatible adjacent development	**VH**		**VH**	**VH**

SITE: Eglin Air Force Base and buffer lands
Name of Target: Barrier island complex
Description: Eglin Air Force Base is responsible for management on Okaloosa Island and parts of Santa Rosa Island, two of the highest quality barrier islands in northwest Florida and south Alabama. The beach, dune, and coastal scrub are restricted to high-energy shorelines along the seaward boundary of these islands. Dune and beach vegetation has three main zones: (1) the shifting beach sands, which have no living vegetation; (2) the produne vegetation, which can tolerate salt spray, shifting sands, and intense heat; and (3) the scrub zone, characterized by stunted, wind and salt spray-pruned scrubby oaks and sand pine with a ground cover of lichens. The rare Santa Rosa beach mouse and green and loggerhead sea turtles utilize these barrier islands. Santa Rosa Island is closed to public recreation, but Okaloosa Island is open. Problems on the barrier islands include feral cats and disturbance of nesting birds, sea turtles, and dune vegetation by recreational users.

Stresses: Barrier island complex

Stress	**Stress Rank**
Light pollution	**M**
Exotic species competition/predation	**H**
Habitat conversion	**H**
Impeded sediment movement	**VH**
Soil disturbance	**H**

Sources of Stress: Barrier island complex

Sources of Stress	**Stresses**					**Overall Threat Rank**
	Light pollution	Exotic species competition/ predation	Habitat conversion	Impeded sediment movement	Soil disturbance	
Foot traffic					**H**	**H**
Vehicle traffic	**L**				**H**	**M**
Sea walls/ docks				**H**		**H**
Exotic species		**H**				**H**
Incompatible development	**H**		**VH**	**VH**	**VH**	**VH**
Incompatible fire management			**M**			**M**

SITE: Eglin Air Force Base, Champion International, Blackwater River State Forest, Conecuh National Forest, NW FL Water Management District, The Nature Conservancy
Name of Target: Depression marsh
Description: Depression marshes, or ephemeral ponds, are shallow, small (less than 1 acre), rounded depressions in sand substrate and are usually characterized concentric rings of vegetation. These ponds are maintained by a subsurface hardpan. Ephemeral ponds dry up most years, with hydroperiods ranging from around 50 to 200 days per year. Because there are rarely fish predators in ephemeral ponds, many species of invertebrates and vertebrates use them to complete their life cycles. Depression marshes are important breeding areas for salamanders, turtles, and frogs such as the flatwoods salamander, cricket frog, striped newt, and gopher frog. Many animals, including raccoons, opossum, and wood storks, feed on amphibian larvae and invertebrates when the ponds are drying up. Fire helps to maintain this community type by restricting invasion of shrubs and trees. Depression marshes are threatened by drainage, fire suppression, exotic species invasion, and fish stocking.

Stresses: Depression marsh

Stress	Stress Rank
Habitat conversion	H
Hardwood encroachment	VH
Soil disturbance	H
Altered hydrology	H

Sources of Stress: Depression marsh

Sources of Stress	**Stresses**				**Overall Threat Rank**
	Habitat conversion	Hardwood encroachment	Soil disturbance	Altered hydrology	
Incompatible fire management	**VH**	**VH**		**VH**	**VH**
Incompatible adjacent development	**H**		**H**	**H**	**H**
Vehicle/equipment impacts			**VH**	**H**	**VH**
Groundwater pumping	**H**			**H**	**H**
Roads and utility corridors	**M**		**M**	**M**	**M**
Incompatible forestry practices	**VH**		**H**	**VH**	**VH**

SITE: Eglin Air Force Base, Blackwater River State Forest, Champion International
Name of Target: Seepage stream/slope complex
Description: Unique streams, known locally as "steepheads" or seepage streams, occur in deep sand soils with rapid percolation of rainwater. Water is stored in the sand aquifer and slowly released as springs or seeps. Seepage streams have relatively invariant flows of clear water of nearly constant temperature running over shifting sand bottoms. Seepage streams form steep headwalls, slopes and ravines as they cut uphill into sand ridges, creating exceptional vertical complexity in an otherwise topographically challenged landscape. The seepage stream complex includes seepage streams, seepage slopes, baygalls, slope forest, upland hardwood forest and upland mixed forest. These systems probably burn every 50-100 years, but the precise fire regime is not well understood. These are arguably the most species-rich systems on GCPEP lands and are extremely important for a host of G1-G2 plant and animal species, including many pitcher plants, the endemic Okaloosa darter and several species of undescribed salamanders. Because sandhill and seepage systems have received such extensive disturbance elsewhere in the Southeast, Eglin's seepage stream complex is among the largest and most important remaining examples.

Stresses: Seepage stream/slope complex

Stress	**Stress Rank**
Altered hydrology	**H**
Sedimentation	**H**
Habitat succession	**H**
Habitat fragmentation	**H**
Loss of canopy cover	**H**
Exotic species competition	**M**
Soil disturbance	**H**

Sources of Stress: Seepage stream/slope complex

Sources of Stress	**Stresses**							**Overall Threat Rank**
	Altered hydrology	Sedimentation	Habitat succession	Habitat fragmentation (riparian corridors & fish movement)	Loss of canopy cover	Soil disturbance	Exotic species competition	
Clay mining	**VH**	**VH**		**H**	**H**	**VH**		**VH**
Roads and road crossings	**VH**	**VH**		**H**	**H**			**VH**
Military test ranges	**H**	**M**		**M**	**M**			**M**
Dams and impoundments	**H**	**H**		**H**	**H**			**H**
Fire plowlines	**H**			**L**		**L**		**L**
Groundwater pumping	**VH**							**VH**
Invasive/exotic species	**H**	**H**				**H**	**M**	**H**
Incompatible forestry	**M**	**VH**			**H**	**H**		**H**
Incompatible fire management			**H**					**H**

SITE: Gulf Coastal Plain Ecosystem Partnership

Name of Target: Blackwater rivers/streams and associated floodplain

Description: Blackwater steams originate in sandy lowlands and drain extensive wetlands of organic soils. The tea-colored water of these streams is colored by tannins, particulates, and dissolved organic matter and iron derived from drainage through wetlands. Blackwater streams have sandy bottoms and are continually shifting. Although these streams are widely distributed in the southeastern coastal plain, many have had major disturbances or alterations and are less biologically productive. Many alluvial rivers are fed by blackwater stream tributaries. The Blackwater River system harbors a high diversity of rare aquatic insects. Main water quality threats are excessive sedimentation from roads, gully erosion from agricultural fields, increased biological oxygen demand from agricultural runoff and growth/development. As of 1998 in northern Santa Rosa County alone, the federal government has spent $2.65 million to attempt to stop 27 gullies.

Stresses: Blackwater rivers/streams and associated floodplain

Stress	**Stress Rank**
Sedimentation	**VH**
Nutrient Enrichment	**H**
Contaminants/Toxins	**M**
Habitat Destruction	**H**

Sources of Stress: Blackwater rivers/streams and associated floodplain

Sources of Stress	**Stresses**				**Overall Threat Rank**
	Sediment	Nutrient Enrichment	Contaminants/ toxins	Habitat Destruction	
Roads, bridges, culverts	**VH**			**VH**	**VH**
Incompatible development (residential, commercial)	**VH**	**H**	**M**	**M**	**H**
Incompatible farming practices	**VH**	**VH**	**H**	**VH**	**VH**
Off-road vehicle use	**VH**			**H**	**VH**
Inadequate Funding	**VH**	**H**		**H**	**H**
Recreation	**H**	**M**		**H**	**H**
Incompatible forestry practices	**M**			**M**	**M**

SITE: Gulf Coastal Plain Ecosystem Partnership

Name of Target: Alluvial rivers/streams and associated floodplain

Description: Alluvial rivers originate in high uplands primarily composed of sandy clays and clayey-silty sands. These rivers are typically turbid due to a high content of suspended particulates and have a large range of flow rates and sediment loads. Flooding which generally occurs once or twice a year, is a controlling factor in the reproductive cycle of many organisms and is also important in providing woody debris, minerals and nutrients to floodplain communities. Portions of three watersheds found in the GCPEP, the Conecuh/Escambia, Choctawhatchee, and Yellow/Shoal are identified as critical systems for protecting at-risk fish and mussels (15, 14, 12, respectively). Of nine freshwater mollusk target species found in GCPEP waters, eight are G1 or G2 species and five are endemic to the Conecuh /Escambia and Choctawhatchee rivers. Main water quality threats are associated with dairy, agricultural and woodland runoff, as well as road runoff, wastewater discharges, and urbanization.

Stresses: Alluvial rivers/streams and associate floodplain

Stress	Stress Rank
Sedimentation	H
Nutrient Enrichment	H
Habitat Destruction	H
Contaminants/Toxins	H

Sources of Stress: Alluvial rivers/streams and associated floodplain

Sources of Stress	**Stresses**				**Overall Threat Rank**
	Sedimentation	Nutrient enrichment	Contaminants/ toxins	Habitat destruction	
Incompatible farming practices	**VH**	**H**	**H**	**H**	**H**
Incompatible wastewater discharge		**H**	**H**	**M**	**H**
Incompatible residential development	**M**	**M**		**H**	**M**
Roads, bridges, culverts	**H**			**H**	**H**
Off-road vehicle use	**M**			**M**	**M**
Inadequate funding	**H**	**H**	**H**	**H**	**H**
Incompatible forestry practices	**M**			**M**	**M**

SITE: Eglin Air Force Base, NW FL Water Management District, The Nature Conservancy
Name of Target: Estuarine systems
Description: The Pensacola Bay system includes five interconnected estuarine embayments (Blackwater Bay, Escambia Bay, East Bay, Pensacola Bay, and Santa Rosa Sound) and is fed by three major rivers (Yellow, Blackwater, and Escambia rivers). The estuary empties into the Gulf of Mexico through a narrow pass at the mouth of Pensacola Bay. The Choctawhatchee River and numerous small streams drain into the Choctawhatchee Bay, which empties into the Gulf of Mexico through a small pass and a man-made canal. Both estuaries historically had high fish and shellfish diversity, but they been experiencing decreases in seafood landings (crabs, shrimp, fish, and oysters) and seagrass beds have virtually disappeared. The estuaries are low energy systems with sluggish currents and are normally stratified, with the upper layer having a lower salinity than the lower layer. Estuarine habitats include seagrass beds, oyster beds, benthic microalgae communities, tidal marshes, tidal flats, and planktonic and pelagic communities. Gulf sturgeon and manatees both utilize the estuaries. Dredging of the mouth of Pensacola Bay and the canal of Choctawhatchee Bay have allowed increased salt water inputs into the two bays and has led to increases in species tolerant of higher salinities.

Stresses: Estuarine systems

Stress	**Stress Rank**
Sedimentation/turbidity	**VH**
Nutrient enrichment	**VH**
Contaminants/toxins	**VH**
Habitat destruction	**H**
Altered circulation	**H**
Altered salinity	**VH**

Sources of Stress: Estuarine systems

Sources of Stress	**Stresses**						**Overall Threat Rank**
	Sedimentation/ turbidity	Nutrient enrichment	Contaminants/ toxins	Habitat destruction	Altered circulation	Altered salinity	
Roads, bridges, seawalls	**VH**			**H**	**H**		**H**
Incompatible development (residential, industrial, municipal)	**VH**	**H**	**VH**	**H**	**H**	**H**	**H**
Incompatible farming practices	**VH**	**VH**	**H**				**VH**
Incompatible forestry practices	**M**						**M**
Canals					**H**	**VH**	**VH**

SITE: Eglin Air Force Base, Blackwater River State Forest, Conecuh National Forest
Name of Target: Red-cockaded woodpeckers
Description: Red-cockaded woodpeckers (RCWs) were federally listed as endangered in 1970 under the Endangered Species Act and have seen dramatic decreases across their range. Declines are due to habitat loss, demographic isolation, fire exclusion/suppression of open pine habitats, and loss of old trees (>100 years) required for cavity excavation. RCWs excavate cavities in living pine trees and have evolved a cooperative breeding behavior that limits habitat occupation to sites that have existing RCW cavities; hence, natural population expansion is slow even when otherwise excellent habitat is available. RCW family groups defend large home ranges (150–500 acres) and viable populations (>100 years) require relatively high densities (300 to 500 breeding pairs) in order to survive expected fluctuations in key habitat and demographic variables. Evidence suggests that RCW productivity is directly related to the diversity and quality of the understory plant-insect community, which is mediated by frequent fire. Because of the large area required to establish and maintain a viable population, RCW recovery is a politically charged issue. On GCPEP lands, Eglin Air Force Base has a large population, which has grown from an estimated population of 217 active clusters in 1994 to 285 in 1998, reversing what appears to have been sharp declines over several decades. Population increases were the result of extensive reintroduction of prescribed fire beginning in 1992, and secondly, due to creation of artificial cavities in suitable unoccupied habitat. Blackwater River State Forest and Conecuh National Forest, on the other hand, have had historically documented declines attributed to loss of cavity trees and suitable foraging habitat. Currently Blackwater has 18 active clusters and Conecuh has 17. Specific population goals have not yet been set for each of the GCPEP lands containing RCWs. RCW population changes (natural rates of increase/decrease) can serve as one indicator of the integrity of fire-maintained longleaf pine ecosystems, and the many species that depend on the open pine habitats preferred by RCWs.

Stresses: Red-cockaded woodpeckers

Stress	Stress Rank
Alteration of natural fire regime	H
Habitat loss and fragmentation	H
Habitat degradation	H
Demographic isolation	H
Cavity tree mortality	M

Sources of Stress: Red-cockaded woodpeckers

Sources of Stress	**Stresses**					**Overall Threat Rank**
	Altered fire regime	Habitat loss and fragmentation	Habitat degradation	Demographic isolation	Cavity tree mortality	
Incompatible forestry (plantations, off-site species)	**H**	**H**	**H**	**VH**		**H**
Incompatible fire management	**H**	**H**	**H**	**H**	**M**	**H**
Incompatible land mgt. (site prep, herbicides)	**H**		**M**			**H**
Catastrophic events (hurricane, wildfire)				**M**	**M**	**M**

SITE: Gulf Coastal Plain Ecosystem Partnership
Name of Target: Florida black bear

Description: Black bears once ranged throughout most of North America in forested habitats. However, black bears now occupy from 5-10% of their historic range in the southeastern United States, mainly in large forested tracts and wetlands in public ownership. Viable populations can exist in highly modified agricultural landscapes, so long as adequate cover remains along rivers and swamps and hunting, poaching and vehicle mortality is kept to a minimum. On Eglin, bears typically spend 95% of their time within 300 meters of creek bottoms. Palmetto berries, insects, acorns and fruits are primary foods. Females have relatively small home ranges, and female offspring are likely to occupy adjacent territories. Males typically have very large home ranges, often overlapping with other males, and encompassing the home ranges of one or more females. Home range sizes vary considerably from population to population. Females give birth to 1–2 cubs every 2–3 years, depending on habitat quality and productivity. The Florida black bear (*Ursus americanus floridanus*) is listed as a threatened species in Florida. Eglin Air Force Base has one of the few apparently stable bear populations in Florida. Population estimates range from 50-75 bears in the immediate area. These bears also use other Gulf Coastal Plain Ecosystem Partnership (GCPEP) lands including Champion International, Northwest Florida Water Management District and possibly Blackwater River State Forest. GCPEP appears to have enough acreage to secure a moderately large population of black bears, and was identified by the Florida Game and Fresh Water Fish Commission as a "strategic habitat conservation area" for the black bear in Florida. This large area of suitable habitat may be critical to the long-term survival of black bears in the western coastal plain. Major threats to long-term persistence include increased mortality due to vehicle collisions and poaching, habitat loss due to urban development and demographic isolation due to habitat fragmentation. A specific population goal has not yet been set, but a minimally viable population is estimated to be 200 adults.

Stresses: Florida black bear

Stress	Stress Rank
Habitat destruction	H
Habitat fragmentation	H
Exotic species invasion of habitat	H
Increased mortality	VH

Sources of Stress: Florida black bear

Sources of Stress	Stresses				Overall Threat Rank
	Habitat destruction	Habitat fragmentation	Exotic species	Increased mortality	
Conversion to agriculture/forestry	**H**	**H**	**H**		**H**
Incompatible development (residential, commercial)	**VH**	**H**			**VH**
Roads and utility corridors	**H**	**H**		**VH**	**H**
Exotic/invasive species	**L**		**H**		**M**
Poaching				**VH**	**VH**

SITE: Eglin Air Force Base, Conecuh National Forest, Blackwater River State Forest, Champion International, NW FL Water Management District

Name of Target: Upland game birds

Description: Hunting of game birds (quail and turkey) is an important recreational activity on GCPEP lands. Quail and turkey require a well-developed, heterogeneous understory for protection from predation. Both birds are ground nesters. The main food sources for game birds are insects and seeds. Breeding and nesting season is from April to September and hunting season runs from October to February for quail and March to May for turkey. Research results are mixed, but it appears that, overall, early growing season fires (early April) are beneficial to game birds because they are protected from hawks during the winter and have an abundance of insects and new green forbs that rebound after the fire. Burning small plots during the summer provides patchy habitat that quail and turkey use for cover and forage. Control of understory hardwoods, usually by fire, is necessary to maintain the understory grasses and herbaceous cover.

Stresses: Upland game birds

Stress	**Stress Rank**
Habitat conversion	**H**
Over-hunting	**M**
Sand pine encroachment	**M**
Hardwood encroachment	**VH**
Food availability	**H**

Sources of Stress: Upland game birds

Sources of Stress	Stresses					Overall Threat Rank
	Habitat conversion	Over-hunting	Sand pine encroachment	Hardwood encroachment	Food availability	
Incompatible fire management	**H**		**M**	**VH**	**H**	**H**
Incompatible hunting management		**M**				**M**
Incompatible development	**H**				**M**	**H**
Incompatible forestry practices	**H**				**H**	**H**

SITE: Eglin Air Force Base, Champion International, Blackwater River State Forest, Conecuh National Forest, NW FL Water Management District

Name of Target: Flatwoods salamander

Description: The flatwoods salamander (*Ambystoma cingulatum*) is a small (5 in.) salamander occupying wet pine flatwoods and scrubby flatwoods with naturally occurring ponds without large predatory fish. Its range is restricted to the lower coastal plain from Mississippi to South Carolina. This species is federally listed as Threatened. Relatively little is known about its natural history, but it appears that individuals have relatively large home ranges of more than 1500 m^2. Adults live fossorially in pine flatwoods— perhaps in crayfish burrows—most of the year, moving to and from breeding ponds or puddles from October through January. Eggs are laid in clumps attached to detritus. Metamorphosis occurs within 90 days, with movement out of ponds and into uplands by March or April. Adults are apparently long-lived, perhaps up to 15 years. Pine flatwoods have been extensively drained and ditched for intensive silvicultural purposes throughout the salamander's range, resulting in locally reduced water tables. Many temporary ponds have been planted in pines or drained, and the common practice of winter burning may have detrimental effects during breeding migration. The common use of herbicides may also be a threat. Habitat bisected by heavily traveled roads may increase mortality. Because they require large home ranges relative to their body size, flatwoods salamander populations are vulnerable to any habitat disturbance that fragments movement or access to breeding ponds. Eglin has the largest breeding population east of the Apalachicola, and relict populations are also found on Champion International lands and Blackwater River State Forest. Eglin's population is considered to be relatively secure and well managed, while its status outside of Eglin is largely unknown. Specific population goals have not yet been set.

Stresses: Flatwoods salamander

Stress	Stress Rank
Non-breeding habitat degradation	H
Increased mortality during migration	H
Alteration of natural fire regime (habitat change)	H
Habitat fragmentation or barriers to movement	H
Loss of breeding ponds	H
Increased predation in breeding ponds	H

Sources of Stress: Flatwoods salamander

	Stresses						
Sources of Stress	Non-breeding habitat degradation	Increased mortality during migration	Altered fire regime (habitat change)	Habitat fragmentation/ barriers to movement	Loss of breeding ponds	Increased predation in breeding ponds	**Overall Threat Rank**
Forestry-related draining or ditching	**H**	**H**			**VH**		**H**
Roads and vehicle traffic	**M**	**M**	**M**	**H**	**H**		**M**
Introduction of predatory fish					**L**	**H**	**M**
Off-road vehicle use	**M**				**M**		**M**
Site conversion to pine plantation	**VH**		**VH**		**H**		**VH**
Groundwater pumping					**H**		**H**

SITE: Eglin Air Force Base, Champion International
Name of Target: Florida bog frog
Description: The Florida bog frog (*Rana okaloosae*) is a small frog (<2 in.) that lives in or along clear, shallow, acid seeps and shallow, boggy overflows of larger seepage streams, frequently in association with sphagnum moss. The predominant shrub/tree at most sites is the black titi. In areas that are infrequently burned, woody species invade and shade out the herbaceous layer, and also lower soil moisture levels. The bog frog's range is restricted to Okaloosa, Walton, and Santa Rosa counties, Florida, and all know localities are on small tributaries to the Yellow or East Bay Rivers. The bog frog breeds from April to August, and tadpoles overwinter and transform the following spring or summer. The bog frog appears to reside year-round in the same areas used as breeding habitat. The main threats to the Florida bog frog are habitat succession due to fire suppression and impoundments. Further inventory is needed to determine the extent of the bog frog's presence on GCPEP lands.

Stresses: Florida bog frog

Stress	**Stress Rank**
Sedimentation	**H**
Habitat degradation	**H**
Altered hydrology	**H**

Sources of Stress: Florida bog frog

Sources of Stress	**Stresses**			**Overall Threat Rank**
	Sedimentation	Habitat degradation	Altered hydrology	
Roads and utility corridors	**VH**	**H**	**H**	**H**
Impoundments	**H**	**VH**	**VH**	**VH**
Incompatible development	**H**	**H**	**H**	**H**
Incompatible fire management		**VH**	**VH**	**VH**
Groundwater pumping			**H**	**H**
Exotic species (feral hogs)	**M**	**H**		**H**

SITE: Eglin Air Force Base

Name of Target: Okaloosa darter

Description: Okaloosa darters (*Etheostoma okaloosae*) were listed as federally endangered in 1973 under the Endangered Species Act. This darter is endemic to the Choctawhatchee Bay system (Okaloosa and Walton Counties, Florida) and the majority of its known range is within the borders of Eglin Air Force Base. The Okaloosa darter was originally listed due to its extremely limited range, and problems associated with water impoundments, sedimentation, and competition with brown darters. Okaloosa darters are typically found along the margins of small creeks fed by groundwater seeping from surrounding sandhills. They tend to avoid areas of low flow and open sand stretches with no cover. Woody debris, root mats and vegetation are used for spawning substrate. Where streams are impounded or subjected to heavy sedimentation, these darters have decreased in numbers and range. Both the Okaloosa darter and the potentially competitive brown darter are found in the Rocky Bayou system, but they appear to have reached a balance. Since the listing in 1973, numbers have decreased in several stream sections (Swift Creek and Mill Creek), but populations in the upper reaches of Boggy and Rocky Bayou stream systems appear stable. Eglin Air Force Base is actively working to restore clay pits and roads that are sources of sediment to darter streams and to modify culverts that have resulted in stream gradients detrimental to Okaloosa darters.

Stresses: Okaloosa darter

Stress	Stress Rank
Sedimentation	H
Habitat degradation	VH
Resource competition	L
Altered hydrology	VH

Sources of Stress: Okaloosa darter

Sources of Stress	**Stresses**				**Overall Threat Rank**
	Sedimentation	Habitat degradation	Resource competition	Altered hydrology	
Roads, culverts, bridges	**VH**	**VH**		**VH**	**VH**
Groundwater pumping				**H**	**H**
Brown darter			**L**		**L**
Impoundments	**H**	**VH**		**VH**	**VH**
Incompatible development	**H**	**H**		**H**	**H**

SITE: Gulf Coastal Plain Ecosystem Partnership
Name of Target: Gulf sturgeon
Description: The Gulf sturgeon is a federally threatened species of fish that migrates us coastal rivers connected to the Gulf of Mexico in spring to spawn. Primary areas of spawning are flowing waters with a rocky, gravel, or hard substrate. The eggs are then broadcast and adhere to the hard bottom features. Occurrence records indicate that most of the large rivers in the GCPEP are used by the Gulf sturgeon including the Escambia,, Yellow, Choctawhatchee and lower Blackwater Rivers. Main threats are loss of spawning habitat and overharvesting (age to maturity and interval between spawning events).

Stresses: Gulf Sturgeon

Stress	**Stress Rank**
Sedimentation	**VH**
Nutrient enrichment	**H**
Contaminants/toxins	**H**
Harvest (poaching)	**VH**

Sources of Stress: Gulf sturgeon

Sources of Stress	Stresses				Overall Threat Rank
	Sedimentation	Nutrient Enrichment	Contaminants/ toxins	Harvest (poaching)	
Incompatible farming practices	**VH**	**H**	**H**		**H**
Incompatible development (residential, commercial)	**VH**	**H**	**H**		**H**
Incompatible wastewater discharge		**VH**	**H**		**VH**
Roads and utility corridors	**VH**				**VH**
Recreation (fishing)				**VH**	**VH**
Inadequate funding	**H**	**H**	**H**	**H**	**H**
Incompatible forestry practices	**M**		**M**		**M**

TABLE 4-3a. Relationship among conservation targets and threats (stresses and sources of stress) at the Eglin AFB site, including some subsites within Eglin. Site planning targets have been somewhat modified to accommodate unique differences among sites.

	Conservation Targets							
THREATS	Longleaf pine sandhill matrix-east	Longleaf pine sandhill matrix-west	Sand pine scrub	Barrier island complex	Depression marsh	Seepage stream/slope complex	Red-cockaded woodpecker-east	Red-cockaded woodpecker-west
Unstable/inadequate funding for management	**H**	**H**						
Roads, utility corridors, culverts, seawalls	**M**	**H**		**H**	**M**	**VH**		
Incompatible fire management/plowlines	**M**	**M**	**H**	**M**	**VH**	**H**	**H**	**L**
Incompatible adjacent development	**M**	**VH**	**VH**	**VH**	**H**			
Incompatible forestry practices	**M**	**M**			**VH**	**H**	**H**	**M**
Harvest (poaching)								
Military mission activities	**M**	**M**				**M**	**M**	**M**
Invasive/exotic species				**H**		**H**		
Groundwater pumping					**H**	**VH**		
Recreation (off-road vehicle and foot traffic)			**M**	**H**				
Impoundments						**H**		

TABLE 4-3a (continued). Relationship among conservation targets and threats (stresses and sources of stress) at the Eglin AFB site, including some subsites within Eglin. Site planning targets have been somewhat modified to accommodate unique differences among sites.

	Conservation Targets					
THREATS	Florida black bear	Upland game birds	Flatwoods salamander	Florida bog frog	Okaloosa darter	**SUMMARY**
Unstable/inadequate funding for management						**H**
Roads, culverts, utility corridors, seawalls	**H**		**M**	**H**	**VH**	**H**
Incompatible fire management/plowlines		**H**		**VH**		**H**
Incompatible adjacent development	**VH**	**H**		**H**	**H**	**H**
Incompatible forestry practices		**H**	**VH**			**H**
Harvest (poaching)	**VH**					**VH**
Military mission activities						**M**
Invasive/exotic species	**M**			**H**	**L**	**H**
Groundwater pumping			**H**	**H**	**VH**	**H**
Recreation (off-road vehicle and foot traffic)			**M**			**M**
Impoundments				**VH**	**VH**	**VH**

TABLE 4-3b. Relationship among conservation targets and threats (stresses and sources of stress) at the Champion International, Blackwater River State Forest, Conecuh National Forest and Northwest Florida Water Management District sites.

	Conservation Targets								
THREATS	Longleaf pine sandhill-flatwood-upland matrix	Depression marsh	Seepage stream/ slope complex	Red-cockaded woodpecker	Florida black bear	Upland game birds	Flatwoods salamander	Florida bog frog	**SUMMARY**
Unstable/inadequate funding for management	**VH**								**VH**
Roads and utility corridors	**H**	**M**	**VH**		**H**		**M**	**H**	**H**
Incompatible fire management/plowlines	**H**	**VH**	**H**	**H**		**H**		**VH**	**H**
Incompatible adjacent development	**VH**	**H**			**VH**	**H**		**H**	**VH**
Incompatible forestry practices	**H**	**VH**	**H**	**H**	**H**	**H**	**H**		**H**
Harvest (poaching)					**VH**				**VH**
Invasives/exotics			**H**		**M**		**M**	**H**	**H**
Groundwater pumping		**H**	**VH**				**H**	**H**	**H**
Recreation (off-road vehicle and foot traffic)	**H**						**M**		**H**
Impoundments			**H**					**VH**	**VH**

TABLE 4-3c. Relationship among riverine/estuarine conservation targets and threats (stresses and sources of stress) within the GCPEP landscape.

	Conservation Targets						
THREATS	Blackwater river/streams-longleaf pine matrix (upper Blackwater River)	Blackwater river/ bottomland hardwood/ longleaf pine matrix (lower Blackwater River)	Alluvial rivers/ streams/ bottomland hardwoods (upper Yellow River)	Alluvial rivers/ streams/ bottomland hardwoods (lower Yellow River)	Estuarine systems	Gulf Sturgeon	**SUMMARY**
Roads, culverts, bridges, seawalls	**VH**	**H**	**H**	**H**	**H**	**VH**	**H**
Incompatible development (residential, industrial)	**M**	**H**	**M**	**M**	**VH**	**H**	**H**
Incompatible wastewater discharge				**H**	**VH**	**VH**	**VH**
Incompatible farming practices	**VH**	**H**	**H**	**M**	**VH**	**H**	**H**
Inadequate/unstable funding	**H**	**H**	**H**	**H**			**H**
Recreation	**H**	**H**				**VH**	**H**
Incompatible forestry practices	**M**	**M**	**M**	**M**	**M**	**M**	**M**

TABLE 4-3d. Relationship between conservation targets and threats (stresses and sources of stress) across the GCPEP landscape. This analyses considers threats to "coarse-scale" species targets that require the majority of the GCPEP landscape to meet the area and habitat requirements for viable populations.

THREATS	Conservation Targets			
	Florida black bear	Red-cockaded woodpecker	Gulf sturgeon	SUMMARY
Incompatible development (residential/commercial, industrial)	**VH**		**H**	**VH**
Roads and utility corridors	**H**		**VH**	**VH**
Smoke management/air quality		**H**		**H**
Incompatible forestry practices/sedimentation		**H**	**M**	**H**
Incompatible agricultural practices/ sedimentation			**VH**	**VH**
Harvest (poaching)	**VH**		**H**	**VH**

TABLE 4.4. Indicators and benchmarks used to evaluate stresses (Center for Compatible Economic Development 1999).

Severity of Damage – what level of damage can reasonably be expected within 10 years under current circumstances	
Very High	The stress is likely to *destroy* or *eliminate* the conservation target
High	The stress is likely to *seriously degrade* the long-term viability of the conservation target
Medium	The stress is likely to *moderately degrade* the long-term viability of the conservation target
Low	The stress is likely to *impair* the long-term viability of the conservation target

Duration/Irreversibility of Damage – how long term is the stress, or how likely is the conservation target to recover from the stress, assuming no intervention	
Very High	The stress is *very long-term* (e.g. 20 years or more) in duration; or the conservation target is *not likely* to ever recover, regenerate or re-establish itself at the site as a viable occurrence
High	The stress is *long-term* (e.g. 10 years) in duration; or the conservation target *may not* recover, regenerate or re-establish itself at the site as a viable occurrence
Medium	The stress is *medium-term* (e.g. 5 years) in duration; or the conservation target is *likely to* recover, regenerate or re-establish itself at the site as a viable occurrence
Low	The stress is *short-term* (e.g. 1-2 years) in duration; or the conservation target is *likely to* recover, regenerate or re-establish itself at the site as a viable occurrence

Scope of Damage – what is the geographic scope of impact on the conservation target at the site	
Very High	The stress is likely to be *very widespread or pervasive* in its scope, and affect the conservation target at its *locations throughout* the site
High	The stress is likely to be *relatively widespread* in its scope, and affect the conservation target at *many of its locations* at the site
Medium	The stress is likely to be *relatively localized* in its scope, and affect the conservation target at *some locations* at the site
Low	The stress is likely to be *very localized* in its scope, and affect the conservation target at a *limited area* at the site

TABLE 4.5. Indicators and benchmarks used to evaluate sources of stress (Center for Compatible Economic Development 1999).

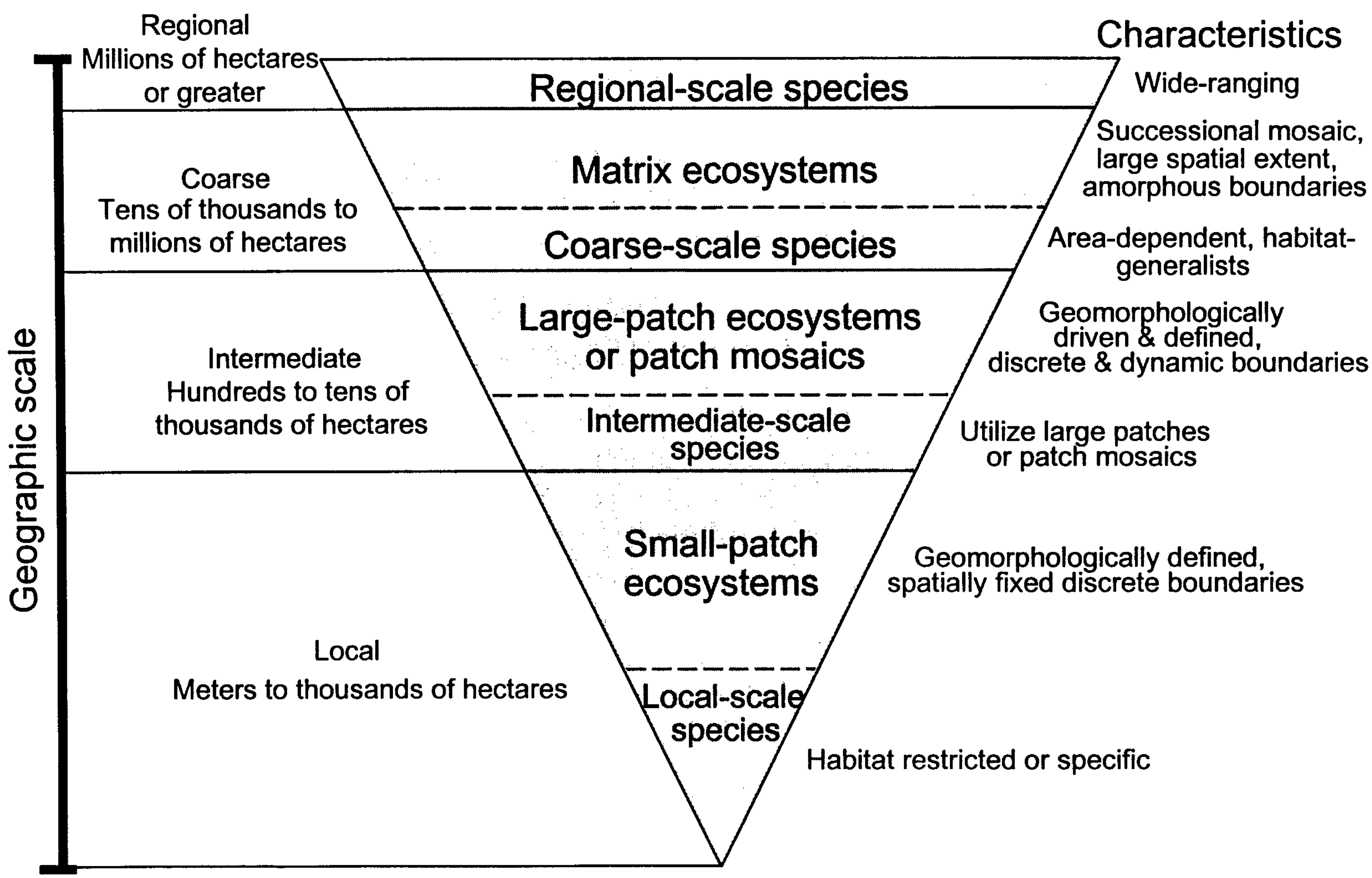
Degree of contribution or "loading" of the Stress that can reasonably be expected to occur from the Source within 10 years, assuming no change in threat abatement	
Very High	The source is a *very large* contributor of the particular stress (e.g. contributes over 80% of the stress)
High	The source is a *substantial* contributor of the particular stress (e.g. contributes 40% to 80% of the stress)
Medium	The source is a *moderate but meaningful* contributor of the particular stress (e.g. contributes 20% to 40% of the stress)
Low	The source is a *low or insubstantial* contributor of the particular stress (e.g. contributes less than 20% of the stress)

Duration/Irreversibility of the Source	
Very High	The source, once in place, is likely to be *very long-term* in duration (e.g. lasting or continuing over 20 years) and/or unlikely to be removed or abated
High	The source is likely to be *long-term* in duration (e.g. lasting over 10 years), and/or could be removed or abated, albeit with difficulty
Medium	The source is of *moderate* duration (e.g. lasting over 5 years), and/or could be removed or abated with moderate difficulty
Low	The source is of *short-term* duration (e.g. 1 to 4 years), and/or could be removed or abated

Urgency	
Very High	The threat is likely to be manifested to a degree that produces a *high impact within one year*
High	The threat is likely to be manifested to a degree that produces a *high impact within two to three years*
Medium	The threat is likely to be manifested to a degree that produces a *high or medium impact within five years*
Low	The threat is real, but *not likely* to manifest to a degree that produces a high or medium impact for five or more years

FIGURE 4-1. Biodiversity planning targets can be usefully organized by geographic scale (figure from Poiani et al. 2000). Conservation targets range from local species with a very limited geographic range (e.g., Florida bog frog) or a geomorphologically defined patch ecosystem (e.g., a sandhill lake) to wide-ranging regional-scale species with large home ranges (e.g., Florida black bear) or regional-scale matrix ecosystems with very broad distributions (e.g., the landscape-level complex of longleaf pine dominated sandhill, flatwood and scrubby flatwood communities).

Biodiversity and scale



CHAPTER 5. GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP PLANNING PROCESS: STEERING COMMITTEE MEETING # 1

Summary of Steering Committee meeting

Meeting summary. The GCPEP Steering Committee serves as the foundation for the conservation planning process. To that end, the first Steering Committee Meeting focused mainly on the planning process. This process is called Site Conservation Planning (Low 1998).

This summary attempted to capture the most important information as recorded on flip charts and transcribed by note takers during the meeting. Editorializing was kept to a minimum except when needed to clarify the context of issues and recommendations. Some of the discussion and recommendations required interpretation. Any errors in translation or interpretation are the responsibility of the author and were unintentional.

Meeting objectives. The Gulf Coastal Plain Ecosystem Partnership (GCPEP) Steering Committee met on December 1–2, 1998 at Bear Lake Recreation Area, Blackwater River State Forest. Issues discussed were to be related to conservation planning and operating guidelines. The meeting was designed to meet the following objectives:

1. Review tentative conservation targets and biodiversity significance of GCPEP;
2. Review seven to ten conservation objectives per partner on lands designated in GCPEP;
3. Agree on and prioritize common conservation objectives;
4. Agree on management challenges to common conservation objectives and list;
5. Review and finalize GCPEP operating guidelines;
6. Agree on procedures for adding new partners to GCPEP.

Tentative conservation targets. The Nature Conservancy presented a report entitled Conservation from an Ecoregional Perspective: The Biodiversity Significance of the Gulf Coastal Plain Ecosystem Partnership. The list of conservation targets was an initial attempt to provide the GCPEP with a conservation overview, realizing that individual partners in the GCPEP may have different species-level targets or none at all. It was hoped that the report would help GCPEP partners focus limited resources on the highest agreed upon conservation priorities.

The significance of the GCPEP lands is clearly stated in the report overview and including such facts as:

- GCPEP comprises only 2% of the 42 million acre East Gulf Coastal Plain Ecoregion area, but includes 38% of its natural communities and 37% of its target species;
- This landscape is considered one of the two most important landscapes in the Southeastern U.S. for conserving biodiversity;
- A national level analysis identified four GCPEP watersheds as critical hotspots for protecting at risk fish and mussel species.

The report also recognized the need for additional information on partner lands concerning occurrences and distribution of both species and community-level targets.

Partner conservation objectives. Each of the partners identified the seven to ten conservation objectives on lands they had designated in GCPEP. Partner lists of these objectives are below. Learning the individual partner objectives will assist the Partnership in recognizing areas of expertise and needs among the partners and across the GCPEP landscape. These objectives will ultimately help shape the long-term conservation strategies and actions of the Partnership.

Champion International
1. Understand biological resources present
2. What's at risk and how to manage
3. Formalization of common map
4. Cooperation to build needed wildlife connectors
5. Successful management of longleaf pine on an economic basis
6. Exotic species control
7. Cooperative erosion control
8. Public recreation management, including interpretation
9. National issues including combining economic and environmental stewardship, prospering with endangered species and emulation of these successes beyond GCPEP to other landowners.

Blackwater River State Forest (Division of Forestry)
1. Longleaf pine / wiregrass restoration
2. Increase prescribed burning
3. Increase public relations and outreach education
4. Protect endangered and other listed species
5. Increase erosion control efforts by controlling public access and improving/closing roads
6. Work on growth management issues within the forest boundary such as purchase of inholdings from willing sellers
7. Improve recreational management, particularly in reference to overuse or damage to areas
8. Control exotic species.

Eglin Air Force Base
1. Support the military mission
2. Restore ecosystem integrity
3. Red-cockaded woodpecker and other endangered/threatened species management
4. Game management
5. Increase prescribed fire to a three to five year rotation
6. Increase cost effectiveness of management activities

7. Protect, maintain and/or improve soil, water and air quality through control of erosion and increased research on aquatic resources/systems
8. Manage outdoor recreation consistent with the military mission (ecotourism)
9. Use adaptive management utilizing GIS, computer simulation models and other tools
10. Emphasize sustainable long-term income from forest management
11. Control exotic species such as hogs.

Conecuh National Forest (National Forests in Alabama)

1. Restore longleaf pine
2. Prescribed burning emphasizing growing season burning
3. Manage to increase the population of red-cockaded woodpeckers
4. Manage for rare and sensitive plants
5. Game management
6. Plan for and manage other recreational uses such as hunting, camping and natural heritage interests
7. Improve forest roads by controlling erosion and permanent or temporary/seasonal closure of needed roads.
8. Increase forest monitoring efforts, both plant and animal
9. Increase public relation effort to assist in meeting the needs of the local and state community
10. Survey for exotic species so control efforts can be initiated.

National Forests in Florida

1. Continue to be a primary donor of red-cockaded woodpeckers
2. Ecosystem management
3. Restore off-site slash pine to longleaf pine while maintaining a healthy groundcover
4. Maintain biodiversity of managed lands
5. Emphasize conservation of soil, water and air quality
6. Provide a sustainable supply of timber and other forest products
7. Prescribe burn on a three year rotation with 50% occurring during the growing season
8. Provide for recreational opportunities
9. Control access to reduce vehicle associated damage
10. Eradicate exotic species

The Nature Conservancy

1. Assist partners in conserving target species
2. Assist partners in conserving functional examples of community types (longleaf pine dominated matrix and embedded communities)
3. Work with each partner to ensure their management actions are biodiversity sensitive and consistent with each partners objectives
4. Work with partners to reduce external stresses and threats, while maintaining consistency with their objectives
5. Work to achieve long-term protection consistent with each partners objectives
6. Engage local people by linking ecosystem protection with economies, health and recreation
7. Learn from the partners

Northwest Florida Water Management District

1. Protect, maintain and improve water resources
2. Provide for protection and enhancement of water resources through integrated management
3. Restore, reforest and manage longleaf pine
4. Maintain existing public access
5. Complete stand description
6. Prioritize and develop action plans for erosion control
7. Protect the wet prairie habitat of Garcon Point with proper burn cycles
8. Enhance the recreation program while protecting the land
9. Continue timber management including loblolly and slash pine stands
10. Control trash/waste dumping through public outreach and road closures.

GCPEP conservation objectives. The development of sound conservation strategies depends upon first determining conservation targets and objectives and then management challenges and system stresses. With this in mind, individual partner conservation objectives were used in preparing the GCPEP conservation objectives. After identifying and discussing the priority objectives on a chart, each partner organization highlighted what they felt were the most important GCPEP objectives.

The objectives follow in priority order:

1. Conserve viable populations of target species
2. Introduce relatively natural fire regimes protecting key ecotypes
3. Protect urban interface and reduce fragmentation by use of conservation easements
4. Control erosion in ecologically sensitive areas
5. Manage recreation and public access

6. Increase communication, interaction and training among partners
7. Increase inventory and monitoring to further adaptive management
8. Increase public education and stakeholder involvement
9. Share resources
10. Secure outside funding and support
11. Inventory and control exotic species
12. Protect aquatic resources
13. Increase understanding of successful economic management of longleaf pine
14. Restore and manage the longleaf pine ecosystem
15. Recover the red-cockaded woodpecker
16. Game management
17. Conservation of examples of functional community types.

Challenges to GCPEP objectives. The partners then used the prioritized list of GCPEP conservation objectives to help in identification of management challenges to these objectives. A list of challenges was identified for each conservation objective. The following table identifies these challenges by objective.

TABLE 5-1. GCPEP conservation objectives and challenges.

Objectives	**Challenges**
Conserve viable populations of target species	1. Lack of systematic inventory 2. Lack of information on management impacts on target species 3. Need for a clear conservation strategy for the connector corridor including use by large mammals and optimum size of corridor 4. Lack of knowledge of biological importance of lands that surround GCPEP 5. Need for prioritizing conservation targets by significance (species and communties)
Introduce relatively natural fire regimes protecting key ecotypes	1. Insufficient acreage burned 2. Insufficient return interval 3. Resistance to growing season burning due to public misconceptions
Protect urban interface and reduce fragmentation by use of conservation easements	1. Inholdings cause fragmentation and increased management problems 2. Fragmentation may harm and cause difficulty in protecting species that require large areas 3. Protection of water resources becomes increasingly difficult with fragmented ownerships
Control erosion in ecologically sensitive areas	1. Graded roads and public access points are major sources of erosion 2. Erosion problems cross partner/non-partner boundaries 3. Lack of native seed source and plant material 4. Lack of funding sources for restoration projects 5. Ecologically sensitive areas needing priority protection not identified

Objectives	Challenges
Manage recreation and public access	1. Lack of information, expertise and personnel to manage recreation carrying capacity and incompatible recreational activities 2. Lack of law enforcement personnel 3. Need for coordination by law enforcement on recreational issues 4. Lack of quantification of negative recreational impacts
Increase communication, interaction and training among partners	1. Lack of internal communication among partners 2. Need for shared GIS as a communications tool 3. Need for establishment of radio and e-mail communication among partners 4. Lack of shared organizational charts and contact lists among partners 5. Need for partner visits with their staff on other partner lands 6. Need for annual report/brochure listing important issues and topics
Increase inventory and monitoring to further adaptive management	1. Lack of common GIS product 2. Insufficient aquatic inventory 3. Lack of monitoring prioritization 4. Insufficient resources for monitoring 5. Mis-matched data sets and methods
Increase public education and stakeholder involvement	1. No communication plan 2. Existing communication is often not strategic. Needs to be related to specific conservation objectives 3. Lack of demonstration areas 4. Lack of information on most effective types of communication
Share resources more effectively	1. Need to document resources that are available 2. need to understand individual partner plans and solidify partnership plans 3. Need to justify and demonstrate benefits 4. Internal rules need to be understood and followed so as to better allow sharing of resources
Secure additional outside funding and support	1. Maintain funding to keep Project Director funded 2. Lack of funding for staff to assist with project management 3. lack of funding for priority projects 4. Need for coordinated partnership response to increase chances of priority project funding 5. Funding restrictions differ by partner 6. Funding cycles differ among partners and sources 7. Need for demonstration and documentation of successes 8. Need for pursuit of non-money resources such as donations and volunteers 9. Need for securing of cooperators that can provide equipment, time and/or money 10. Need for strategy development with cooperators
Exotic species control	1. Lack of inventory 2. Problem originates on non-partner lands 3. Aggressive spreading of exotic species on partner lands from private property and roads 4. Lack of knowledge on methods and techniques for control 5. Need for coordination of control treatments 6. Need for identification of additional funding sources

Objectives	Challenges
Protection of aquatic resources	1. Insufficient inventory of resources 2. Limited control and influence due to parts of watersheds being outside of partner lands 3. Increased water use related to increasing urban development 4. Need for aquatic management plan
Restoration and management of longleaf pine ecosystem	1. Need for groundcover protection during management and restoration 2. Lack of available cost information on reforestation, restoration and management 3. Lack of market for hardwood removal contracts 4. Possiblity of Champion/Eglin landscape management strategy on connector parcel 5. Need for combined partnership contracts on herbicides, chipping or other restoration techniques to reduce site prep costs 6. Need for parntership agreements on restoration objectives

Conservation of examples of functional community type. It was agreed upon by the partners to use the GCPEP tentative conservation targets, conservation objectives and management challenges to assist in the next steering committee meeting in the development of conservation strategies. First, major stresses and sources of stress to the priority natural systems will be identified by the partners to assure priority identification of the conservation strategies. Stresses may be defined as impacts to natural systems caused by destruction, degradation or impairment to a system. Often stresses are caused by incompatible human uses of resources, but may be caused by natural phenomena. For each stress there may be one or more causes or sources of stress. Identifying sources precisely is important, as addressing each different source may require very different strategies.

Other issues

Operating guidelines. A Memorandum of Understanding (MOU) was signed by the partners in 1996. The MOU serves as the foundation of the partnership. The Steering Committee agreed upon the following operating guidelines to insure efficient operation of the partnership.

1. Each partner chooses representatives. The Steering Committee consists of a primary and alternate contact. The alternate contact may be represented by a designee chosen by the primary contact. There is one primary contact and one alternate contact per partner. Attendance and representation by each partner at the steering committee meetings is encouraged.
2. Consensus is desired in reaching agreements among the partners. If there is minority dissent, then the majority is charged with finding an alternative solution acceptable to all. The goal is to always maintain productivity while keeping the consensus process efficient.

A suggestion was made to consider having a Co-Chair for the Steering Committee. The Project Director currently serves as the Chair. Responsibilities of the Co-Chair were recommended to include working with the Chair on setting meeting agendas and serving as an

additional public relations spokesperson. The position was recommended to rotate annually among the partners. It was agreed that further discussion was needed by and between the partners before the next steering committee meeting.

New partners. Two agencies approached GCPEP during 1998 expressing interest in joining the Partnership. The Steering Committee agreed that the addition of new partners should be based on objectives, targets and needs of GCPEP and that all new partners should be landowners. It was also recommended that an application process should be considered in which clearly defined benefits to GCPEP could be stated. Any application would be reviewed by the Steering Committee and agreement by consensus would be required. The partners clearly desire to work with cooperators in the GCPEP area and recognize their importance to the overall success of the partnership. Steering Committee consensus was to continue discussion on new partners during the next meeting.

Next meeting. The next steering committee meeting will be June 22-23, 1999 at the Champion International Research Office near Jay, Florida. The goal of the meeting will be to develop draft GCPEP conservation strategies and actions. Five to seven prioritized projects will be identified with measurable goals. After the meeting Champion will provide a tour of their Forest Resources and Land Management programs.

CHAPTER 6. GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP PLANNING PROCESS: STEERING COMMITTEE MEETING #2

Summary of Steering Committee meeting

Meeting summary. The second meeting of the Gulf Coastal Plain Ecosystem Partnership Steering Committee served to continue the conservation planning process. The focus of the meeting centered on identification of threats and development of strategies to abate these threats. The goal was to end with major cooperative projects that would address the key strategies.

Meeting objectives. The GCPEP Steering Committee met on June 22-23, 1999 at the Champion Forest Genetics Research Program office near Jay, Florida. The goal of the meeting was to develop a common set of voluntary conservation strategies consistent with each partner's individual legal mandates, mission and objectives. Strategies addressed the challenges and threats identified in the previous GCPEP Steering Committee Meeting from December 4-5, 1998. Current and future funding and the addition of new partners were also discussed. The meeting was designed to address the following objectives:

1. Assess GCPEP conservation status;

2. Review key stresses and threats on GCPEP lands;

3. Develop strategies to abate critical threats;

4. Identify major projects, addressing key strategies;

5. Discuss new partners;

6. Discuss GCPEP funding: current and future;

7. Tour Champion International lands and projects.

Assess GCPEP conservation status. A report prepared by The Nature Conservancy for the GCPEP Steering Committee titled *The Gulf Coastal Plain Ecosystem Partnership: An Assessment of Conservation Opportunities* (Hardesty et al., 1999) was given to each steering committee member. The report focused on conservation of biological diversity in the context of GCPEP. It was intended to be used as a reference throughout the meeting for the development of GCPEP conservation strategies. The report contains a discussion on conservation planning at the ecoregional and the site level. Also covered are site planning targets, a socioeconomic assessment, and a summary of the previous GCPEP Steering Committee meeting.

GCPEP members asked The Nature Conservancy to develop a regional assessment of biodiversity that the GCPEP could use to shape their collective conservation strategies. The partners tentatively adopted a set of conservation targets, species and natural communities that become the focus of conservation effort, as suggested by Conservancy staff. The Nature Conservancy used a planning process termed ecoregional planning to determine which sites in

the U.S. have the greatest conservation value. The ecoregional classification adopted by The Nature Conservancy is a modification of that adopted by the U.S. Forest Service (Bailey 1995).

The ecoregional planning process consists of:

1. Subdividing the United States into ecoregions based on Bailey's classifications (1995). Ecoregions are areas that are large enough to cover processes and occurrences of rare and imperiled species and natural communities. They are, however, small enough within which to plan, identify partners and take action;
2. Using the ecoregion as the basic planning unit;
3. Reviewing all available information on the status of species, ecological groups and natural communities to choose ecoregional conservation targets. Ecoregional conservation targets consist of G1-G2, declining, imperiled or keystone species, and all representative natural communities or ecological groups;
4. Setting quantitative ecoregional conservation goals as targets (e.g., 10 populations of bird species X, each population with at least 100 breeding pairs);
5. Assessing all known occurrences of targets across the ecoregion to choose a suite of conservation sites sufficient to meet the ecoregional target goals. A site is a defined place in the ecoregion that is sufficiently large enough to protect viable populations of target species and/or functional examples of natural communities or ecological groups.

The East Gulf Coastal Plain ecoregion covers 42,439,000 acres, stretching from northeastern Louisiana across the southern portions of Mississippi, Alabama, Georgia and western Florida. The Nature Conservancy identified 310 target species (148 vascular plants, 1 lichen, 73 invertebrates, 28 fishes, 12 amphibians, 20 reptiles, 15 birds, and 13 mammals) and 297 target natural communities that are considered to be rare, imperiled or of conservation concern. The exceptional biological diversity in this ecoregion ranks it among the richest in North America. Unfortunately, historical and current rates of alteration and habitat loss also make its biological resources among the most threatened.

The GCPEP landscape, despite encompassing less than 2% of the 42 million acre ecoregion, includes 37% of the target species and 38% of the natural communities of the ecoregion. Many of the partner lands host endemic or near endemic species and communities, and thus have an important role to play in conservation at a larger scale. Eleven species within the GCPEP landscape are federally endangered or threatened. Sixty-one of the target species occurring on GCPEP lands have Natural Heritage ranks of G1, G2, T1, or T2, meaning that from a global perspective they have extremely limited distribution. Of these, 16 (and perhaps more) occur only within the GCPEP managed areas, and nowhere else.

GCPEP lands also include portions of the Escambia-Conecuh, Blackwater, Yellow-Shoal and Choctawhatchee River watersheds. A recent assessment of North American freshwater systems identified three of these watersheds as important hotspots for protecting at-risk fish and mussels and critical for conserving freshwater biodiversity in the United States. Of the 12 freshwater mollusk target species found in GCPEP managed areas, nine are G1 or G2 species (Master, Flack, and Stein, 1998), and six are endemic to the watersheds of the GCPEP landscape.

Once conservation targets have been chosen for a site through ecoregional planning, managers should then choose a smaller subset of targets that occur at the site for planning purposes. The known conservation needs of the ecoregional targets that occur at the site can be used to determine site boundaries and local threats to long-term persistence. This process is called site conservation planning.

Site conservation planning has the following components:

- Identifying the ecoregional target species and natural communities that are present at a given site that serve as the site conservation targets;
- Assembling and assessing all available ecological information pertinent to the targets and the site;
- Assembling and assessing pertinent socioeconomic information;
- Using this information to assess the threats to the targets at the site. A threat is defined as a stress and its source. For example, erosion causes habitat smothering in Okaloosa darter streams (stress) as a direct result of runoff and gully formation from roads and borrow pits (source of stress).

At the site level, the appropriate choice of planning targets is the single most important step. Resulting management strategies are directed at abating the threats to persistence of these planning targets, and indirectly the entire suite of conservation targets. Greg Low, in his manual *Landscape-Scale Community-Based Conservation* (Low 1998) states that "the goal is to choose a set of conservation targets that represent multiple levels of biological organization, have different life history requirements, depend on different ecological processes and encompass a variety of different spatial scales." He adds that "in effect, planning targets act as conservation umbrellas or surrogates, however imperfectly, for all other similar target species and natural communities occurring in the geographic area". Attempting to use all conservation targets for planning purposes is often impossible because large sites may have numerous targets and because we know so little about many species-level targets. Planning targets are thus used to cumulatively address the ecological requirements for all species and communities occurring at a site.

In addition to the choice of species and communities as the focus of conservation efforts, The Nature Conservancy also currently defines four overlapping geographic scales: local, intermediate, coarse and regional. These scales are used to define functional conservation areas capable of sustaining biodiversity over the long term. The boundaries of a site will vary with the ecological needs of different targets. Any one landscape can consist of a number of differently sized and shaped sites nested within the larger landscape. Black bears would be an example of a coarse-scale species because they require large, relatively undisturbed areas, use many different natural community types, and require abundant safe movement corridors between home ranges. An example of a local-scale species would be a rare plant that inhabits only a certain limited soil type or a small geographic area, such as the Cooley's Meadowrue.

Of the 115 species-level ecoregional targets that occur in the GCPEP landscape, the Partners chose eight as planning targets. They were chosen because they were either declining across their range, they are found on GCPEP lands or waters, and/or they would not necessarily

be protected through management of natural community level targets. GCPEP species-level targets are:

- Okaloosa darter;
- Florida bog frog;
- Gulf sturgeon;
- Red-cockaded woodpecker;
- Black bear;
- Flatwoods salamander;
- Aquatic fish/mussel complex; and
- Game birds.

Of the 115 ecoregional community/ecosystem-level targets that occur on GCPEP lands and waters, 10 matrix-forming community types were chosen as planning targets. Each of these matrix community types protects rare, threatened and endangered species. The assumption is that if these systems are managed appropriately, then the majority of species-level targets would be protected. GCPEP community-level targets are:

- Pitcher plant bogs;
- Barrier island complex;
- Estuarine systems;
- Ephemeral ponds;
- Sand pine scrub;
- Longleaf pine sandhill matrix;
- Longleaf pine flatwoods matrix;
- Seepage stream/slope complex;
- Blackwater rivers/streams; and
- Alluvial rivers/streams.

Review key stresses and threats on GCPEP lands. Once conservation targets were identified by GCPEP, threats could then be articulated. *Threats* are anything that compromises the long-term viability of the target at a site. A threat is defined as a stress and its source. Understanding the difference between a stress and its source will ensure the selection of the right conservation strategies to address critical threats. For example, a proposed road may be called a threat in a creek system. We are then drawn to the conclusion that we must stop construction of the road. Threat: road. Solution: stop road. However, if we separate the threat into stress and source, the stress isn't the road. The stress is loss of flow and associated erosion. That formulation of stress inclines us to think, instead, of ways to keep flood waters flowing through the corridor that is the proposed location of the road. A bridge that spans the major flood plain may be the answer. Examples of other stresses include altered fire regimes, habitat destruction, fragmentation, and exotic species.

For each stress on a given target, there may be one or more causes or sources of stress. An example would be nutrient loading, which is a stress to many aquatic ecosystems. Excess nutrients in the water draw off oxygen leading to fish kills and harm to other aquatic life.

However, the nutrient loading might be caused by many different sources, such as septic systems, sewage treatment facilities, suburban runoff, farm fertilizers, and improper grazing. Other sources of stress include incompatible development, incompatible agricultural practices, filling of wetlands, and fire suppression. It is critical to precisely identify the most important source, because addressing each different source often requires a very different strategy.

At most sites one (or a few) threat often emerges as the "killer threat". This single threat, if not addressed, may cause destruction or irreparable harm to a conservation target. Tables 6-2a-d combine the original eight targets and threats (in this case, sources of stress) by site. Rankings are all based on expert opinion, including GCPEP partners, with reference to the relative severity and immediacy of the threat to the target. Additionally, the rankings act as a filter for developing and prioritizing conservation strategies.

Develop strategies to abate critical threats. Conservation strategies are designed to abate threats to conservation targets at sites. The way we respond, or fail to respond, to critical threats will very likely be the single most important factor affecting the long-term health of the conservation targets on GCPEP lands. If the threat is not serious or not likely to occur, then some type of low-cost holding action or no action would be appropriate. If the threat is serious, then potential strategies to address critical threats should be evaluated using three criteria:

- Benefits;
- Probability and feasibility;
- Costs.

There is no shortage of worthwhile ideas. There is, however, a shortage of resources for completing strategies. The GCPEP partners identified "killer" threats to begin their strategy identification work. These threats (sources of stress) to the original eight targets are identified in Tables 6-2a-d. For each source of stress, strategies and actions are identified in Table 6-1.

TABLE 6-1. Strategies and actions for major sources of stress for GCPEP conservation targets.

SOURCE OF STRESS	STRATEGIES AND ACTIONS
Incompatible residential and commercial adjacent development	• Each partner must identify specific purposes and needs for acquisition of land. Of these, identify most threatened. End product should be a map. • Identify parcels already on acquisition lists. • Identify most desirable parcels for acquisition to protect buffers. • Identify mechanisms, partners, and funding for acquisition. • Use the sale of Choctawhatchee National Forest lands near Eglin for funding to acquire Conecuh National Forest or Eglin acquisitions. • National Forests in Florida and Alabama, The Nature Conservancy, and Eglin work on mechanisms for sale of Choctawhatchee National Forest lands.

Inadequate/unstable funding	• Learn outcome of Florida Governors Report on Prescribed Burning. • Cooperate with Pensacola Bay Ecosystem Management Advisory Council for FEMA funding for road and erosion control projects. • Pursue external funding of $10,000 for helicopter prescribed burning assistance. • Establish GCPEP burn crew (10 people, 6 months/year). • Pursue GCPEP targets inventory funding. Funding to possibly come from non-game grant, TNC, USFWS, USFS cost share, Champion, DEP, National Council for Air & Stream Improvement, and EPA. • Project Director to interview partners on target lists and inventory needs. Aquatic Ecologist at Eglin to interview partners on aquatic inventory needs. • Project Director and TNC staff to develop list of funding sources for conducting conservation target inventories on partner lands.
Incompatible fire management	• Consider a public opinion poll and/or focus groups to craft a pro-fire message for stakeholders and the general public. • Contact the Florida Division of Forestry, the Governors Council on Fire and the North Florida Prescribed Fire Council on public education and/or polling after the 1998 Florida wildfires. • Work with Garry Peterson to complete the fire model for Blackwater River State Forest and Conecuh National Forest. • Assist Eglin Air Force Base with Cape San Blas burn.
Incompatible silviculture and land management practices	• Hire graduate student to compile information on herbicide/mechanical site preparation and ground cover. • Partners send available aquatic inventory information to Project Director to compile and send to GCPEP. • Arrange tour or workshop looking at herbicide rates, longleaf pine restoration and groundcover composition. Tour may include Eglin Air Force Base, Longleaf Pine Project, Blackwater River State Forest and Conecuh National Forest. Workshop to cover longleaf pine restoration and species composition goals. • Christina Kennedy from Duke University to provide land cover mapping information. • Compile information on longleaf pine growth and yield model. Discuss cooperating on this project with the Longleaf Alliance.
Roads and utility corridors	• Partners to pursue info on laws related to road BMP's from the Department of Environmental Protection and the Northwest Florida Water Management District. • Pursue funding for demonstration projects, BMP development and outreach person to work with counties. • Complete report on GCPEP roads, erosion, and impacts. Report to be presented to the Bay Area Resource Council.

Other Issues

Identify major projects, addressing key strategies. After identifying strategies and actions to abate critical threats, the partners agreed upon a list of work projects to immediately begin or complete work on. The projects follow in priority order.

1. Pursue Choctawhatchee National Forest land exchange or sale. Chris Zajeck of Apalachicola National Forest in Tallahassee will be the point person. Also involve Conecuh National Forest, Eglin Air Force Base, the Alabama Heritage Program, and George Willson of The Nature Conservancy.
2. Each partner identify critical parcels for land management or protection of conservation targets. Complete a map and state why the parcel was selected. Complete by September 30, 1999.
3. Pursue public opinion poll. Project Director to discuss with TNC Government Relations and Gary Taylor of Conecuh National Forest. Jeff Hardesty (TNC) to discuss with Susan Jacobsen (University of Florida). Funding to be committed by October 1, 1999.
4. Finish fire model for Blackwater River State Forest and Conecuh National Forest. Host workshop for stakeholders. Rick Lint to provide Conecuh map. Project Director to provide needed information to Garry Peterson.
5. Project Director to approach Alabama and Florida Natural Heritage Inventory programs and DEP Ecosystem Management Coordinators for possibility of producing target maps for GCPEP.
6. GCPEP Burn Team to review and possibly pursue funding from National Turkey Federation. Team to include James Furman (Coordinator) from Eglin Air Force Base, Sonny Greene from Blackwater River State Forest, Pat Brinn or Michael Heard from Conecuh National Forest, and Steve Brown from the Northwest Florida Water Management District. Recommendations to be made by September 30, 1999.
7. Compile report on herbicide impacts on groundcover in the longleaf pine ecosystem. The Longleaf Pine Restoration Project at Eglin Air Force Base will complete by December 30, 1999.
8. Complete assessment of aquatic systems status. Rick McWhite of Eglin Air Force Base will take the lead on developing a rapid assessment technique. Team to assist will include Kevin Leftwich of the National Forests in Alabama, Joe DiVivo of Eglin Air Force Base, and the GCPEP Aquatic Specialist.

Discuss new partners. Interest has been expressed by organizations outside the partnership in joining or learning more about GCPEP. Those interested have included the Naval Air Station, Alabama Forestry Commission, Hancock Timber Resource Group, and the Florida Department of Environmental Protection (Blackwater River State Park).

The GCPEP Steering Committee previously agreed that the addition of new partners should be based on objectives, targets, and needs of GCPEP and that all new partners should be landowners. It was also recommended that an application process should be considered in which clearly defined benefits to GCPEP could be stated. Any application would be reviewed by the

Steering Committee and agreement by consensus would be required. It should be noted that the partners clearly desire to work with cooperators in the GCPEP area and recognize their importance to the overall success of the partnership.

During further discussion on new partners, the Steering Committee agreed that a Committee should be formed to determine draft eligibility criteria and membership categories. The committee will consist of Arden Shropshire of Champion International and Jeff Hardesty of The Nature Conservancy.

GCPEP funding: current and future. With the current staffing, equipment, travel, and vehicle budget, approximately $120,000/year is needed for GCPEP to operate. Funding for GCPEP, including salary for the Project Director and other Conservancy staff who provide assistance, has been provided by the following:

- Department of Defense Legacy;
- Champion International;
- The Nature Conservancy;
- Turner Foundation;
- Dunn Foundation;
- Camp Younts Foundation;
- Gulf Power Corporation/Southern Company.

The success of GCPEP is due in part to all who have provided support through the initial planning process and the startup of cooperative projects. Additional funding has been secured by The Nature Conservancy for two positions to assist GCPEP with priority projects selected by the partners. The first position to be filled will be an Aquatic Specialist, shared with the Apalachicola River & Bay Project. The second position will be a Conservation Biologist to assist with conservation planning and inventory associated with targets selected by the partners. These positions will have initial funding for one year.

Tour of Champion International lands and projects. The meeting concluded with a well designed and organized tour of the Champion connector parcel. The tour highlighted parcel management objectives. Tour stops included an erosion control/restoration project, hardwood orchard, sand pine orchard, southern pine trial planting, Florida bog frog site, and a slash/longleaf pine flatwood site. Discussions during the tour were very helpful in giving the partners a better understanding of Champion goals and objectives.

Next meeting. The next steering committee meeting will be in late October or early November. A partner host for the meeting has not been selected at this time. The goal of the meeting will be to complete the planning process for the new conservation targets chosen by the steering committee at this meeting. In addition, project updates will be given, and short and long-term cooperative projects with measurable goals will be selected.

TABLE 6-2a. Relationship among conservation targets and threats (stresses and sources of stress) at the Eglin site, including some subsites within Eglin. Site planning targets have been somewhat modified to accommodate unique differences among sites.

	Conservation Targets							
THREATS	Longleaf pine sandhill-flatwoods matrix-east	Longleaf pine sandhill matrix-west	Seepage stream/slope /rare species complex	Red-cockaded woodpecker-east population	Red-cockaded woodpecker-west population	Florida black bear	Flatwoods salamander	**Summary**
Unstable/inadequate funding for management	**H**	**H**	**H**	**L**	**L**	**H**		**M-H**
Roads and utility corridors	**M**	**H**	**VH**	**M**	**L**	**VH**	**M**	**M-H**
Incompatible fire management/plowlines	**H**	**VH**	**H**	**VH**	**H**			**H-VH**
Incompatible adjacent development (residential/commercial)	**M**	**VH**	**VH?**			**VH**		**H-VH**
Incompatible silviculture/land management practices	**VH**	**H**	**VH**	**VH**	**L**		**M**	**H**
Harvest (poaching)						**VH**		**VH**
Military mission activities	**M**	**H**	**H**	**M**	**M**			**M-H**

TABLE 6-2b. Relationship among conservation targets and threats (stresses and sources of stress) at the Blackwater River State Forest site.

THREATS	**Conservation Targets**					
	Longleaf pine sandhill-flatwoods matrix	Seepage stream/slope rare plant complex	Red-cockaded woodpecker	Florida black bear	Flatwoods salamander	**Summary**
Unstable/inadequate funding for management	**M**	**H**	**H**	**VH**	**M**	**H**
Roads and utility corridors	**H**	**VH**	**M**	**VH**	**M**	**H**
Incompatible fire management/plowlines	**VH**	**M**	**VH**	**L**	**VH**	**M-VH**
Incompatible adjacent development (residential/commercial)	**VH**		**M**	**VH**	**H**	**H-VH**
Incompatible silviculture/land management practices	**M**	**VH**	**H**	**L**	**VH**	**H**
Harvest (poaching)				**VH**		**VH**

TABLE 6-2c. Relationship among conservation targets and threats (stresses and sources of stress) across the GCPEP landscape.

THREATS	Conservation Targets						
	Blackwater river/streams-longleaf pine matrix(upper Blackwater River)	Blackwater River/bottom land hardwood/ longleaf pine matrix (lower Blackwater River)	Alluvial rivers/ streams/ bottomland hardwoods (upper Yellow River)	Alluvial rivers/ streams/ bottomland hardwoods (lower Yellow/ Shoal River)	Gulf Sturgeon (Yellow/ Shoal River-Pensacola Bay)	Aquatic Fish/Mussel Complex (Yellow/ Shoal River)	**Summary**
Incompatible land use (roads, bridges)	**VH**	**M**	**L**	**M**	**M**	**M**	**M-H**
Incompatible economic development	**L**	**H**	**L**	**M**	**M**	**M**	**M**
Incompatible residential development	**L**	**H**	**L**	**VH**	**VH**	**VH**	**M-VH**
Incompatible wastewater discharge	**L**	**H**	**L**	**H**	**H**	**H**	**M-H**
Incompatible farming practices	**H**	**M**	**H**	**H**	**H**	**VH**	**H**
Inadequate/unstable funding	**H**	**H**	**H**	**H**	**H**	**H**	**H**
Recreation	**VH**	**H**	**L**	**M**	**VH**	**H**	**H**

TABLE 6-2d. Relationship among conservation targets and threats (stresses and sources of stress) across the GCPEP landscape. These analyses consider threats to "coarse-scale" species targets that require the majority of the GCPEP landscape to meet the area and habitat requirements for viable populations. *The Gulf sturgeon is a tentative planning target.

	Conservation Targets			
THREATS	Florida Black Bear	Red-cockaded Woodpecker	Gulf Sturgeon*	**Summary**
Incompatible development (residential/commercial)	**VH**			**VH**
Roads and utility corridors	**VH**			**VH**
Smoke management/air quality		**H**		**H**
Incompatible silviculture/sedimentation			**H**	**H**
Incompatible agriculture/ sedimentation			**H**	**H**
Harvest (poaching)			**H**	**H**

CHAPTER 7. GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP PLANNING PROCESS: STEERING COMMITTEE MEETING #3

Summary of Steering Committee meeting

Meeting summary. The third meeting of the GCPEP Steering Committee centered on operational issues surrounding a large landscape-scale project and project updates. Cooperative projects with measurable successes form the foundation of any partnership.

Meeting objectives. The Gulf Coastal Plain Ecosystem Partnership (GCPEP) Steering Committee met on December 2-3, 1999 at Jackson Guard, Eglin Air Force Base in Niceville, Florida. The goal of the meeting was to consider operation issues, projects and strategy identification. Projects and strategies would address the challenges and threats identified in the December 4-5, 1998 GCPEP Steering Committee Meeting. The meeting was designed to address the following objectives:

1. Finalize on several GCPEP operation issues including addition of new partners and job expectations for GCPEP staff;
2. Review status of major projects;
3. Continue strategy and action identification;
4. Identify new projects with measurable goals and expectations.

GCPEP Operations. A Memorandum of Understanding was signed by the partners in 1996. The MOU serves as the foundation of the partnership. The Steering Committee agreed upon the following operating guidelines to ensure efficient operation of the partnership.

1. Each partner chooses representatives. The Steering Committee consists of a primary and alternate contact. The alternate contact may be represented by a designee chosen by the primary contact. There is one primary contact and one alternate contact per partner. Attendance and representation by each partner at the steering committee meetings is encouraged.
2. Consensus is desired in reaching agreements among the partners. If there is minority dissent, then the majority is charged with finding an alternative solution acceptable to all. The goal is to always maintain productivity while keeping the consensus process efficient.

Since the formation of the partnership, several agencies and companies have expressed interest in GCPEP. The Steering Committee agreed over the past year that the addition of new partners should be based on objectives, targets and needs of GCPEP. A committee consisting of Arden Shropshire of Champion International and Jeff Hardesty of The Nature Conservancy was formed at the June 1999 meeting to determine draft eligibility criteria. These draft criteria were presented to the Steering Committee and after review, discussion and minor modifications, the criteria were agreed upon by all.

New Partner Criteria.

1. Understand and support the purposes of GCPEP and can clearly articulate both what their organization has to gain from and what they plan to contribute to the partnership.
2. Meets one or both of the following criteria:
   a) Manage and/or own significant land or water holdings in the GCPEP geographic area[1], with strong preference given to those sharing a border with one or more existing GCPEP partners, and/or;
   b) Can offer significant expertise in one or more of the following management or conservation disciplines: Forestry, water and watersheds, wildlife, biodiversity, prescribed fire, endangered species or recreation.
3. Commit to appointing and sending at least one and preferably two representatives to all GCPEP Steering Committee meetings and other functions as needed.
4. Agree to take lead or co-lead responsibility on one or more cooperative GCPEP projects per year.
5. Agrees in principle to provide financial or operational support to the core partnership, either as direct funds or as in-kind support, and agrees to seek additional resources to support cooperative projects.
6. Understands and agrees to adhere to the GCPEP operating guidelines.
7. Agree to keep all appropriate people within their organization informed and knowledgeable about GCPEP purposes and activities.

Steering Committee Job Expectations for all GCPEP Staff. At a minimum, once each year, job expectations of the GCPEP staff will be reviewed by the Steering Committee. Suggestions from the Steering Committee will be included in the job objectives for each staff member. Job summaries and duties are provided for the two new positions. Steering Committee expectations for all GCPEP positions are listed below.

Project Director, Steering Committee Job Expectations:

1. Initiate new partner contacts and screen all candidates. Report back to Steering Committee.
2. Develop and complete Site Conservation Plan for GCPEP.
3. Acquire private and/or public funding to support GCPEP operations.
4. Oversee and/or assist implementation and planning for cooperative projects with partners.
5. Continue select involvement in groups and councils critical to GCPEP mission.
6. Administration of GCPEP support.
7. Improve communications within the partnership.

Aquatic Specialist Responsibilities. The Aquatic Specialist position will be split between two programs, the Apalachicola River and Bay and the GCPEP. The region covered by these two projects in the Florida panhandle is rich in aquatic biodiversity. The Aquatic Specialist will work closely with the Apalachicola Project Manager and the GCPEP Project Director in strengthening aquatic conservation activities in these areas. In the GCPEP area, the Aquatic Specialist will be

[1] Generally, from the Gulf of Mexico in the south, to the Escambia-Conecuh River watershed in the west, to the Choctawhatchee River in the east, to the southern most counties in Alabama.

responsible for doing a rapid ecological assessment of the creeks and rivers of the region and will assist in prioritizing areas for conservation activities. In addition to working with the GCPEP, work will also occur within the community to build support for aquatic ecosystem protection and to encourage Best Management Practices (BMPs) on private and public lands.

Aquatic Specialist Duties.

1. Complete rapid ecological assessment of GCPEP creeks and rivers and prioritize areas for conservation activities. Host aquatic conservation planning meetings for GCPEP and selected personnel.
2. Participate in the development of a basinwide monitoring program for the Apalachicola-Chattahoochee-Flint (ACF) basin. Work with state and federal partners in identifying biological monitoring needs for the aquatic and estuarine ecosystems associated with the allocation formula. Assist in designing a monitoring plan that will meet those needs.
3. Increase partner capacity for conservation, monitoring and restoration of freshwater biodiversity by acting as a contact between agencies and with other experts. Identify monitoring needs for the accomplishment of the conservation goals of the Apalachicola River and Bay and GCPEP projects. Design and implement monitoring plans to address these needs.
4. Research and provide aquatic biodiversity conservation information to GCPEP and other partners. Assist GCPEP Project Director and Apalachicola Project Manager in preparing reports and issue papers.
5. Assist in the implementation of aquatic conservation strategies identified in the site conservation plans.
6. Build political support for aquatic ecosystem protection by serving on the Bay Area Resource Council, Choctawhatchee Basin Alliance and other selected watershed protection groups. Represent GCPEP and The Nature Conservancy concerning aquatic issues at selected workshops and conferences.
7. Assist in grant writing and identifying sources of funding.
8. Assist the GCPEP Project Director and the Apalachicola Project Manager with other duties as needed.

Aquatic Specialist, Steering Committee Job Expectations:

1. Prioritize stream segments/watersheds for biodiversity protection and identify threatened sites. Develop action plan to address problems. Research the availability of aquatic data/information.
2. Develop monitoring design and criteria. Review Eglin's monitoring design and coordinate with the Aquatic Biologist. Also coordinate with Alabama and Florida state agencies, and Federal agencies including U.S. Forest Service (USFS), U.S. Fish & Wildlife Service (USFWS) and the U.S. Geologic Survey (USGS).
3. Identify reference streams in the GCPEP area.
4. Develop a GCPEP plan of action on target species.
5. Provide training to GCPEP personnel, especially standard operating procedures for aquatic sampling.
6. Provide expertise and advice on stream restoration techniques.

7. Cooperate with continuing education, such as Master Logger BMP training.
8. Complete literature searches on deadhead logging, roads and other activities that may impact aquatic systems. Provide partners with research information.

Project Administrator responsibilities. Provides administrative and technical support to the GCPEP Project Director. Manages the administrative aspects of GCPEP, such as answering the telephone, routine correspondence, travel arrangements, purchasing and producing routine documents. Prepares and tracks project contract and grant budgets. Assists with research and literature searches. Organizes workshops and meetings. Coordinates project communications needs. Coordinates project human resource needs. Assists with project fundraising.

Project Administrator Duties.

1. Manage the administrative needs of the GCPEP project. This includes handling secretarial support to the Project Director and administrative activities such as correspondence, travel arrangements, maintaining files, telephone answering, tracking documents, producing routine reports, purchasing and administering the petty cash budget.
2. Manage project contracts and grants. Coordinate all reporting requirements. Prepare project budgets as needed. Track and monitor expenses. Act as liaison to subcontractors we hire.
3. Coordinate project communications needs, such as writing, editing, designing, producing and reviewing documents. Work with TNC staff to develop media strategies and plan media events.
4. Assist with project information management, conduct literature searches and maintain literature database.
5. Organize workshops, meetings and training sessions aimed at natural resource managers, scientists and TNC staff.
6. Assist with project development/fundraising needs, such as research for and production of grant proposals.
7. Act as a resource for general personnel information, benefits and policies. Generate all paperwork on new and terminated positions and personnel changes and forward to Florida Chapter Office.
8. Other duties as assigned.

Project Administrator, Steering Committee Job Expectations:

1. Communicate GCPEP budgetary needs to the Steering Committee on a regular basis. Include GCPEP equipment needs in partner notifications.
2. Assess GCPEP communication needs by working closely with each partner's Public Relations staff.
3. Develop communication strategies including displays, slides and issue papers.
4. Improve GCPEP internal communications with progress reports, calendars and Email newsletters. Distribute a GCPEP newsletter on a quarterly basis.
5. Work with the Steering Committee to develop a GCPEP logo for use on all correspondence.

Other Issues

Major Project Updates. At the previous GCPEP Steering Committee Meeting, strategies and actions were developed for the most serious threats to GCPEP conservation targets. The

conservation strategies selected were chosen to abate threats to the conservation targets. From these strategies, eight major projects were chosen to initiate work on. An update on each of these major projects follows:

1. ***Pursue Choctawhatchee National Forest land exchange or sale. Chris Zajeck of Apalachicola National Forest in Tallahassee will be the point person. Also involve Conecuh National Forest, Eglin Air Force Base, the Alabama Heritage Program and George Willson of The Nature Conservancy.***

The National Forests in Florida manages 12 parcels in Santa Rosa, Okaloosa and Walton counties, all of which are part of the original Choctawhatchee National Forest. Currently negotiating with St. Joe on possible exchange for parcels St. Joe owns in the Apalachicola National Forest. Walton County is interested in one parcel for a possible industrial park. The National Forest in Florida wishes to sell the remaining parcels to provide needed funding to purchase other critical parcels in and around other national forest lands.

2. ***Each partner identify critical parcels for land management or protection of conservation targets. Complete a map and state why the parcel was selected. Complete by September 30, 1999.***

   a) Northwest Florida Water Management District priorities include the Yellow and Escambia Rivers and the Garcon Point peninsular. Currently nearing closing on Yellow River parcels north of land under current management. Could consider Blackwater River or tributaries if connected to water protection.

   b) Division of Forestry mainly pursuing in holding parcels. Will consider parcels abutting state lands if it assures protection of major tributaries of the Blackwater River.

   c) Champion International presented a map showing land management categories for lands they manage, ranging from high yield areas to protected areas. The Steering Committee identified protecting the Champion connector parcel as critical. This is especially critical due to the rapid growth that is occurring along the Highway 90/Interstate 10 corridor. Conservation Easements may be a beneficial option for both Champion and other partners also.

   d) Eglin Air Force Base is concerned about encroaching buffer development, which interferes with mission testing and with land management. Important buffer parcels include Escribano Point, First American Farms and the Shoal River Ranch. Escribano Point has been on the P2000 list previously. GCPEP supports acquisition of this parcel under the new Florida Forever program. The Nature Conservancy agreed to help in every way possible to assure this parcel is purchased and protected from development.

   e) Conecuh National Forest also pursuing in-holdings. The Nature Conservancy has assisted with the purchase of some parcels. Purchasing in holdings is difficult due to large number of parcels, the need for appropriation of funding and the lack of personnel.

f) The Nature Conservancy has identified important parcels for protecting biodiversity. Many of these parcels are of concern also to the partnership. The need is great for additional Protection staff time for GCPEP to acquire land parcels of concern as quickly as possible. There is also a need for a compelling map showing the GCPEP area and all partnership parcels of concern. GCPEP staff will work on completing this map.

3) ***Pursue public opinion poll. Project Director to discuss with TNC Government Relations and Gary Taylor of Conecuh National Forest. Jeff Hardesty (TNC) to discuss with Susan Jacobsen (University of Florida). Funding to be committed by October 1, 1999.***

The GCPEP Project Director discussed with the TNC Government Relations Staff. Jeff Hardesty (TNC) discussed with Susan Jacobsen of the University of Florida. The Project Director is currently pursuing funding for conducting the poll and has included this request into one funding proposal. The Steering Committee agreed that it was important to assure that GCPEP was providing the needed educational information to the surrounding communities. Sometimes the problems managers feel are most critical to the local communities are not the same ones the communities recognize. Community profiling creates a more accurate picture of community attitudes and values. There are several different types of profiling, including focus groups, surveys, one-on-one interviews and newspaper content analysis. Each of these tools is capable of collecting certain types of information.

4) ***Finish fire model for Blackwater River State Forest and Conecuh National Forest. Host workshop for stakeholders. Rick Lint to provide Conecuh map. Project Director to provide needed information to Garry Peterson.***

Rick Lint of Conecuh National Forest and Tom Arrington of Blackwater River State Forest have provided the necessary maps. Project Director will set up schedule to complete the fire model with Garry Peterson. Steering Committee agreed we should consider the possibility of a GCPEP burn team or a GCPEP Fire Resource Coordinator. Jim Murrian noted the successful interagency, cooperative fire team organized for the Lake Wales Ridge area. Both public and private funding was use for this fire team. Burn plans for the partnership lands are aggressive for the next year with the following acreage planned:

• Conecuh National Forest	25,000 acres
• Blackwater River State Forest	65,000 acres
• Eglin Air Force Base	100,000 acres
• Apalachicola National Forest	100,000 acres

Andy Colannino, Apalachicola National Forest, mentioned the possibility of using Fire Training Center teams or USFS teams needing training with different fuels in different settings. The National Forest in Florida needs only prior notification to plan for such a training event.

5) ***Project Director to approach Alabama and Florida Natural Heritage Inventory programs and DEP Ecosystem Management Coordinators for possibility of producing target maps for GCPEP.***

Project Director has not approached Natural Heritage programs about production of needed GCPEP maps. However, the Director has worked with Christina Kennedy of Duke University on a possible directed study with an end product of GCPEP GIS maps. Christina presented her proposal consisting or two possible products, a threat analysis or an ecological uniqueness analysis (see attached proposal). The Steering Committee agreed that creating an up to date GCPEP map and completing a threat analysis would be most beneficial. Main concerns are development pressures, smoke management, recreation, roads and population density.

6) ***GCPEP Burn Team to review and possibly pursue funding from the National Turkey Federation. Team to include James Furman (Coordinator) from Eglin Air Force Base, Sonny Greene from Blackwater River State Forest, Pat Brinn or Michael Heard from Conecuh National Forest and Steve Brown from the Northwest Florida Water Management District. Recommendations to be made by September 30, 1999.***

GCPEP Burn Team discussed in Project #4.

7) ***Compile report on herbicide impacts on groundcover in the longleaf pine ecosystem. The Longleaf Pine Restoration Project at Eglin Air Force Base will complete by December 30,1999.***

The report by the Longleaf Pine Restoration Project will be completed and discussed at the next GCPEP Steering Committee Meeting. The report will consist of a literature review of herbicide effects on groundcover species in southern pinelands. Included will be relevant, peer-reviewed articles from journals, technical reports, theses and agency literature. To date, over 100 articles have been scrutinized. After careful reading, 35 papers were retained that met the primary objective of the report. The studies varied enormously in quality. Beyond quality issues, the following additional challenges had to be overcome in order to pursue statistical analysis.

- Few studies share common treatments
- Few studies report on the same variables
- Some studies measure treatment effects from a few lumped variables (all herbaceous plants), whereas others subdivide treatment effects at the species level.

The next steps of the study are to choose variables and treatments, decide how many to keep from each study and then to decide if there are enough studies to perform statistics on. To date, it has not been possible to gage the prevalence of negative or positive effects because the data is too heterogeneous. General observations are that the positive effects of herbicides may be more common than negative ones when herbaceous plant species are grouped into life forms (forbs, grasses). This may occur if a dominant species such as broomsedge responds positively to herbicide application.

8) ***Complete assessment of aquatic systems status. Rick McWhite of Eglin Air Force Base will take the lead on developing a rapid assessment technique. Team to assist will include Kevin Leftwich of the National Forests in Alabama, Joe DeVivo of Eglin Air Force Base and the GCPEP Aquatic Specialist.***

First, the GCPEP Aquatic Specialist will conduct a rapid assessment of partner aquatic resources. Then, she will work with the Eglin/USFWS Aquatic Ecologist on a GCPEP long term monitoring plan. This team will also include the Aquatic Specialists from Champion International, National Forests in Alabama and the Northwest Florida Water Management District.

<u>Additional Major Projects Selected</u>. The Steering Committee decided with the remaining meeting time it was important to select additional projects the partners could work cooperatively on. Projects are identified along with project leader(s).

1) GCPEP hosted red-cockaded woodpecker translocation meeting, scheduled for August 2000. The purpose of meeting is to discuss translocation of birds within the southern region. All recipient locations of red-cockaded woodpeckers must be present at the meeting and make a case for receiving birds from a donor population. Jim Murrian (TNC), Andy Colannino (Apalachicola National Forest) and the Project Director will work on the feasibility of the proposal.
2) Research the possibility of a GCPEP Volunteer Coordinator. Andy (Eglin) will contact the Project Director and other partners. Rick McWhite (Eglin) and Jim Murrian (TNC) will lead this effort. Recommendations will be made to the Steering Committee on whether to have a GCPEP Volunteer Coordinator or not.
3) GCPEP Prescribed Fire Resource Council. The Project Director will discuss with the partners and other possible cooperators.
4) The Nature Conservancy hire a dedicated Land Protection Specialist for western Florida and south Alabama. Jim Murrian and Larry Ellis (TNC) and the Project Director will work with TNC Protection staff to discuss this need. Recommendations will be offered to the Steering Committee.
5) GCPEP host an annual meeting to celebrate successes.
6) Possible GCPEP site on partner web pages. GCPEP Project Administrator and/or Director will contact partners and report back to Steering Committee.
7) Partners assist the Northwest Florida Water Management District with a prescribed burn on the Garcon Point Clark parcel.
8) Complete one cooperative GCPEP burn each year.
9) Compile GCPEP success stories. Project Administrator will work on including in a quarterly GCPEP Newsletter.
10) Find funding to conduct target surveys on partner lands. GCPEP Staff will pursue funding opportunities for terrestrial and aquatic targets surveys.

The meeting concluded with an evaluation and a discussion on possible dates for the next Steering Committee meeting. The dates April 6-7, 2000 were selected and Conecuh National Forest volunteered to host the meeting.

CHAPTER 8. GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP PLANNING PROCESS-STEERING COMMITTEE MEETING #4

Summary of Steering Committee meeting

Meeting summary. The fourth meeting of the GCPEP Steering Committee reflects the growth, successes and challenges of a strong, cooperative partnership. Project updates and operational issue discussions were an important component of the meeting. Partner updates on needs and issues emerged as a desired topic for all future meetings. Additional planning for new conservation targets represents the changing needs across the GCPEP landscape.

The Steering Committee members in attendance were Steve Brown, Vernon Compton, Joe Cox, Stephanie Davis, Larry Ellis, Rick Lint, Jim Murrian, Carl Petrick and Ad Platt. The guests were Jon Blanchard and Andrea Litt. Perrin Penniman attempted to capture the most important information as recorded on flip charts and tape recorder during the meeting. Editorializing was kept to a minimum except when needed to clarify the context of issues and recommendations. Some of the discussion and recommendations required interpretation. Any errors in translation or interpretation were unintentional.

Meeting objectives. The Gulf Coastal Plain Ecosystem Partnership (GCPEP) Steering Committee met April 6–7, 2000 at Conecuh National Forest, Andalusia, Alabama. The goal of the meeting was to consider operational issues, project updates and identification and strategy identification. Projects and strategies would address the challenges and threats identified in the December 4–5, 1998 GCPEP Steering Committee Meeting. The meeting was designed to address the following objectives:

- Finalize several GCPEP operational issues including addition of new partners and job expectations for GCPEP staff;
- Review status of major projects;
- Partner updates;
- Conservation target strategy and action identification.

An information manual was given to each Steering Committee member containing articles on conservation planning, herbicides, gulf sturgeon, aquatic woody debris, coastal plain streams, biological monitoring and amphibians.

GCPEP Operations. GCPEP has been fortunate to hire three additional staff to support the partnership. These positions were chosen first because of needs, threats and strategies identified by the Steering Committee members. At a minimum of once each year, job expectations of the GCPEP staff will be reviewed by the GCPEP Steering Committee. Suggestions from the Steering Committee are included in the job objectives for each staff member.

- The Aquatic Specialist was funded for the first year 50% from a Dunn Foundation grant and 50% from a TNC Freshwater Initiative (FWI) grant. The Aquatic Specilaist works 50% of the time for GCPEP and 50% of the time for the Apalachicola Bay and River program. Next fiscal year the Aquatic Specialist position will again be jointly funded by the GCPEP and Apalachicola programs.

- The Project Administrator is funded by TNC and DOD to work for GCPEP. Conecuh National Forest supports GCPEP with funds and Champion International donates office space to the entire GCPEP staff.
- A Project Conservation Ecologist position is in the process of being filled. This position is funded by TNC and DOD. Job expectations for this position were agreed upon by the Steering Committee.
- The GCPEP Aquatic Specialist and Project Administrator reviewed their own job responsibilities, duties and expectations prior to covering their work accomplishments of the last quarter.

<u>Aquatic Specialist Job Accomplishments:</u>
Job <u>Expectations</u> are numbered and <u>Accomplishments-</u>to-date are bulleted
(Responsibilities and Duties are detailed in Chapter 7.)

1. Prioritize stream segments/watersheds for biodiversity protection and identify threatened sites. Develop action plan to address problems. Research the availability of aquatic data/information.
2. Develop monitoring design and criteria. Review Eglin's monitoring design and coordinate with the Aquatic Biologist. Also coordinate with Alabama and Florida state agencies, the USFS, USFWS and the USGS.
3. Identify reference streams in the GCPEP area.

- Aquatic site visit wirh each partner to better understand the partners' lands and the goals each of them has for the aquatic resources.The sites visited were with Blackwater River State Forest, Champion International, Conecuh and Eglin staff. A meeting with NWFWMD is scheduled to occur in May.
- Training took place on the Florida Department of Environmental Protection's Bio Reconnaissance and habitat assessment protocol, with visits to DEP's lab to become familiar with the facilities, protocols and resources.
- Monitoring discussions and training continued with USFWS, Eglin, FL DEP, Florida Fiah and Wildlife Conservation Commission (FFWCC), and TNC. Meetings with these agencies to discuss regional monitoring ensure that efforts are not being duplicated. Introduction of an Adopt-a-Stream program for Florida that could aid in monitoring efforts was discussed.
- The Aquatic Specialist participated in a meeting with national Nature Conservancy Freshwater Initiative (FWI), USFWS and FFWCC to discuss aquatic classification for North Florida. Work will continue with this group to pursue aquatic classification for the GCPEP area waters. Environmental Protection Agency (EPA) funding was pursued for aquatic classification and aquatic surveys in our area, but no university would take the lead on the grant.
- Sampled insects on Eglin AFB with FL A&M University biologists
- Participated in TNC Freshwater Initiative planning retreat, SE Division staff retreat and International Science and Stewardship conference

4. Develop a GCPEP plan of action on target species.

   - Literature and information on aquatic targets in the GCPEP area has been collected. Discussions with experts will continue to work on a plan of action for the aquatic targets including mussels, gulf sturgeon, Okaloosa darter, fish and mussels in Conecuh, Blackwater and alluvial systems. The aquatic specialist has participated in several meetings at Eglin concerning aquatic and biodiversity issues, including the Aquatic Resource Management meeting and the Okaloosa darter Recovery Plan meeting.
   - The aquatic specialist attended a workshop on steephead ravines hosted by the Florida Benthological Society that included talks on hydrology, geology, insects, vegetation and amphibians and a site visit to ravines near Bristol, FL.

5. Provide training to GCPEP personnel, especially standard operating procedures for aquatic sampling.
6. Provide expertise and advice on stream restoration techniques.

   - Expertise was provided for a restoration project at Blackwater River State Forest in the Mare Creek area, funded in part by DEP penalty money. A heavily used road fords both Mare Creek and a small, unnamed branch. Driving through these creeks has made them wider and shallower downstream and the habitat is silted over. In order to reduce these impacts, a Bailey Bridge is being constructed across Mare Creek and a rock ford across the small branch. The Department of Forestry (DOF) is also rebuilding the road, blocking off go-arounds and closing vehicle access to roads that lead to sandbars. Pre-restoration biological and habitat evaluations were conducted on the two streams with the assistance of DEP and Blackwater staff. The sites will be re-sampled one year after the restoration to evaluate the impacts of the project. Though Mare Creek and the small creek are both heavily smothered, they have good woody debris and good potential for recovery.

7. Cooperate with continuing education, such as Master Logger BMP training.
8. Complete literature searches on deadhead logging, roads and other activities that may impact aquatic systems. Provide partners with research information.

   - A list of the rare and imperiled plants and animals that live in and around the streams and wetlands in the GCPEP region is being compiled. Information on woody debris and log removal from rivers is being compiled and distributed to interested parties. Scientific evidence has been presented about why log removal is detrimental to streams and rivers.
   - A report and poster on aquatic resources and issues in the Blackwater River watershed entitled "*A Guide to Understanding and Protecting the Blackwater River Watershed*" was published as an effort of the GCPEP Staff , TNC Regional Staff and other cooperators. The project was funded by a DEP In-Kind Service Penalty Payment mentioned above. The report is aimed at community leaders to discuss problems and solutions in the watershed and to highlight current protective actions.

Three of the top eight conservation objectives chosen by the Steering Committee were:

1. Control erosion in ecologically sensitive areas
2. Manage recreation and public access
3. Increase public education and stakeholder involvement.

The Blackwater River guide represents an initial effort at addressing these objectives.

- Slide shows and displays are being presented at meetings on topics such as GCPEP, non-point source pollution, river stewardship and aquatic woody debris. Spoke to NW FL Canoe Club about deadhead logging.
- Apalachicola River and Bay duties

<u>Project Administrator Job Accomplishments:</u>
Job <u>Expectations</u> are numbered and <u>Accomplishments</u>-to-date are bulleted
(Project Administrator Responsibilities and Duties are detailed in Chapter 7.)

1. Communicate GCPEP budgetary needs to the Steering Committee on a regular basis. Include GCPEP equipment needs in partner notifications.
2. Assess GCPEP communication needs by working closely with each partner's Public Relations staff.
3. Develop communication strategies including displays, slides, and issue papers.
4. Improve GCPEP internal communications with progress reports, calendars and e-mail newsletters. Distribute a GCPEP newsletter on a quarterly basis.
5. Work with the steering committee to develop a GCPEP logo for use on all correspondence.

- Transferred all GCPEP administrative responsibilities to the Jay, FL office that were previously handled in Gainesville, FL including accounting, human resources, public relations establishing and maintaining files, compiling mailing lists and research information, and tracking expenses.
- Met with TNC Florida Regional Staff on FY 2001 GCPEP budget & future needs
- Reviewed and tracked documents to gain a thorough understanding of public and private grant reporting requirements to produce required funding deliverables for critical GCPEP funding.
- Submitted pre-proposal for FY 2001 Legacy grant; Prepared Quarterly Reports for TNC Stewardship, Legacy Program, Solutia/DEP In-Kind Penalty, Steering Committee Meetings; Prepared Final Reports for Solutia/DEP In-Kind Penalty and The Turner Foundation
- Increasing GCPEP communications, including assessing needs, developing strategies and working to improve external and internal communications.
- Co-wrote and distributing "A Guide to Understanding and Protecting the Blackwater River Watershed".
- The first two editions of an internal newsletter, the GCPEP Partners' Quarterly News were produced in February and March 2000.
- Working closely with the GCPEP partners and public relations departments to produce a logo for GCPEP letterhead, brochure and public newsletter about the partnership for community support and fundraising. Other requests include a slide or PowerPoint

presentation and video documentary.

- Compiling information and attending workshops about organizing volunteers.

Project Conservation Ecologist Responsibilities. A Project Conservation Ecologist will soon be added to the GCPEP staff and the position will focus on planning on Eglin Desired Future Condition Workshop, increasing the planning and monitoring for GCPEP Conservation Targets and synthesizing ecological information for the partners.

Project Conservation Ecologist Duties.

1. Synthesize ecological and conservation planning information for identified conservation targets at Eglin. Work with the TNC Southeast Division Conservation Ecologist, Eglin G.I.S. and operational staff and other TNC staff to prepare background materials for an Eglin Desired Future Condition Workshop.
2. Take lead role in organizing Eglin Desired Future Condition Workshop and assist with workshop facilitation. Assist with organization of other workshops as scheduled.
3. Develop report on Eglin Desired Future Condition Workshop and work with Dr. Garry Peterson on completion of a landscape disturbance model for partner sites.
4. Work with GCPEP partners on conservation planning and development of site conservation plans for Eglin and other partner sites.
5. Write the ecological portions of GCPEP reports and other communication efforts geared toward specified audiences.
6. Assist the GCPEP staff in grant development and fundraising efforts.
7. Compile new scientific and management information at the species and community level for GCPEP sites.
8. Develop and implement monitoring programs for identified conservation targets.
9. Assist with other activities as requested by the Project Director.

Project Conservation Ecologist, Steering Committee Job Expectations:

1. Attend North Florida Prescribed Fire Council Meetings and USFS NEPA Meetings. Learn the process and assist in the future. Assist with Eglin 5 year Management Plan.
2. Work with Engineer/Road Maintenance departments on solutions to erosion problems using Road Best Management Practices (BMP's). Prepare a manual for Road BMP's.
3. Work on Integrated Exotic Species Management Plan for GCPEP and area lands. Coordinate an exotic species treatment information and equipment exchange between the partners.
4. Prepare a "GCPEP Native Species for Restoration" guide, for large-scale restoration projects listing plant availability, propagation and production information. Possibly purchase equipment to collect native seed.
5. Assist with a "Native Plants for Groundcover Restoration" workshop for GCPEP at Apalachicola Preserve.
6. Work on management guidelines for GCPEP Conservation Target beginning with the Florida bog frog. Visit known sites on Eglin and Champion International lands and investigate possible new sites.
7. Work on G.I.S. mapping needs for GCPEP. Follow-up on Christina Kennedy's map. Research Longleaf Alliance's possible availability to coordinate G.I.S. efforts with GCPEP. Research downloading already prepared maps of partners and other agencies.

8. Work on hog impacts on rare plant communities including pitcher plant bogs and other conservation targets. Include in threats, strategies and management plans. Research hog management in other areas and agencies in the state. Research projects and funding sources including Lake Wales Ridge working on hog enclosures to reduce threats.
9. Plant native trees on specific soil types and prepare a guide for Arbor Day handout "GCPEP Native Tree Plantings for Local Communities".
10. Assist in coordinating release of gopher tortoises.

Other Issues

New and Current Partner Discussions. The National Forests in Florida have been very supportive of GCPEP from the beginning, especially in the area of management and red-cockaded woodpeckers. However, with the distance between GCPEP lands and the major land holdings of the National Forests in Florida, and with increasing budget and personnel constraints, they are continually faced with difficult decisions. Recently, Forest Supervisor, Marsha Kearney, indicated the need for the National Forests in Florida to withdraw from GCPEP. The withdrawal was based on several issues including a concern over repetition with National Forests in Alabama and the need for increased personnel effectiveness and efficiency. It is clear, though, that GCPEP continues to have the full support of the U.S. Forest Service.

Additional discussions are occurring with the National Forests in Florida regarding roads, recreation, public access and the Florida National Scenic Trail. The National Forests in Florida also have land responsibility for one of eight National Scenic Trails in the United States, the Florida National Scenic Trail. GCPEP, under the guidance of the Steering Committee, is playing, and can continue to play, a critical role in the completion of the Florida National Scenic Trail in the panhandle.

Considering a change to their Steering Committee members to reflect National Forest and GCPEP needs in the area of recreation and eco-tourism can be beneficial to the Steering Committee by bringing in additional expertise in an area the partnership has chosen as a priority objective – management of recreation and public access and increasing public education and stakeholder involvement.

New Partner Criteria are detailed in Chapter 7.

Several agencies and/or landowners have expressed some level of interest in joining GCPEP. These possible partners include the Florida Fish & Wildlife Conservation Commission, John Hancock, Naval Air Station, Pensacola and the Florida Department of Environmental Protection. The partners also discussed cooperating more closely with Gulf Islands National Seashore. The Steering Committee has requested that the GCPEP Project Director conduct initial meetings with the interested parties. To date, the Project Director has met with the Alabama Nature Conservancy and Alabama Natural Heritage Programs to learn more about South Alabama landowners, of which one, John Hancock, owns property in and around Conecuh National Forest. An initial meeting will be set with John Hancock and information will be brought back to the Steering Committee.

Major Project Updates. At the previous GCPEP Steering Committee meeting, strategies and actions were developed for the most serious threats to GCPEP conservation targets. The conservation strategies selected were chosen to abate threats to the conservation targets. From

these strategies, eight major projects were chosen to initiate work on. An update on each of these major projects follows:

1. ***Pursue Choctawhatchee National Forest land exchange or sale. Chris Zajeck of Apalachicola National Forest in Tallahassee will be the point person. Also involve Conecuh National Forest, Eglin Air Force Base, the Alabama Heritage Program, and George Willson of The Nature Conservancy.***

   Currently Apalachicola is working to sell this parcels in a way that will most benefit the National Forest in Florida, including negotiating with St. Joe on possible exchange for parcels St. Joe owns in the Forest.

2. ***Each partner identify critical parcels for land management or protection of conservation targets. Complete a map and state why the parcel was selected. Complete by September 30, 1999.***

   a) Yellow River – Project Director worked with Steve Brown and Bill Cleckley of the Northwest Water Management District on the pursuit of a 12,384-acre parcel Rayonier was selling that included land along the Yellow River. The land was previously owned by Jefferson Smurfit Corporation and was purchased by Rayonier in October of 1999. All Florida lands were put up for purchase by bid with a January 2000 closing. Upon learning of this purchase possibility, the NWFWMD could not complete legal requirements in time to put in a bid. TNC also did not have time to do appraisals. However, both expressed an interest to Rayonier if the parcels did not sell.
   b) East Fork Coldwater Creek, Manning & Wolf Creeks –These are important tributaries of the Blackwater River. Discussed with Champion first about the possibility of purchasing property because of proximity to other Champion parcels, but the purchase was not a possibility. Then discussed with both Blackwater River State Forest and the Northwest Florida Water Management District. The parcel was another Rayonier piece (6045 acres) for purchase by bid. For the same reasons as the Yellow River property, they could not bid on it. However, this parcel was bought by a landowner from Alabama, who has turned around a put it up for sell again. The Division of Forestry is currently pursuing the inholding and all land along Coldwater Creek.
   c) Escambia River – The Project Director met with the landowner interested in a partner or a conservation easement for a 590 acre parcel along the Escambia River. Put in contact with Steve Brown of the Northwest Florida Water Management District and he will now follow up on this.
   d) Escribano Point- a 6,500-acre parcel lying west of Eglin and east of Garcon Point on East Bay. Escribano Point has been on the P2000 list previously. GCPEP supports acquisition of this parcel under the new Florida Forever program. One letter was written by the Project Director to Eglin about military and land management issues, such as prescribed burning. DEP is taking the lead and is now actively pursuing this property. Letters have been sent to all landowners expressing interest. The largest landowner, Louisiana Development Corporation, is interested in selling and is doing appraisals. DEP has completed appraisals and surveys. The Nature Conservancy agreed to help in every way to assure this parcel is purchased and protected from development. Possible managers

for this property include the Northwest Florida Water Management District and the Yellow River Aquatic Preserve.

e) Clark Property – DEP has purchased some critical parcels in the Garcon Point Area, to be managed by the Yellow River Aquatic Preserve. One is a 40-acre parcel in the middle of the Clark property. DEP has also purchased land on some of their North boundaries and has received permission to do additional appraisals.

f) Conecuh National Forest – Conecuh is pursuing inholdings and TNC has assisted with the purchase of some parcels. Purchasing inholdings is difficult due to the large number of parcels, the need for appropriation of funding and the lack of personnel. Conecuh met with Alabama TNC and NHP staff to discuss important parcels in and around Conecuh National Forest. Alabama TNC is pursuing appropriation of additional Federal funds to assist Conecuh in purchase of critical inholdings. For the Forest Service, most projects take approximately a year or more to finalize, but with it is very helpful having TNC's help because they have a quicker timeline.

g) Mid Bay Timber/First American Farms–Highway 331 Landowner wants to consider doing something positive for conservation with this parcel. This could be a model for restoring agricultural lands back to a longleaf pine ecosystem. It is highly disturbed with the possibility of seepage slopes.

3) Pursue public opinion poll. Project Director to discuss with TNC Government Relations and Gary Taylor of Conecuh National Forest. Jeff Hardesty (TNC) to discuss with Susan Jacobsen (University of Florida). Funding to be committed by October 1, 1999.

Met with the Longleaf Alliance and discussed the possibilities of doing a joint community profiling project.

4) Finish fire model for Blackwater River State Forest and Conecuh National Forest. Host workshop for stakeholders. Rick Lint to provide Conecuh map. Project Director to provide needed information to Garry Peterson.

Maps have been provided by the partners. The GCPEP Project Conservation Ecologist will take the lead on completing theis project with the scientist who completed the model for Eglin, Dr. Garry Peterson.

Eglin Air Force Base:

30,000-acres have been burned on Eglin. The objective is 70,000-acre minimum and 100,000-acre optimum. Drought and military missions have caused postponements.

Conecuh National Forest:

11,000-acres burned, finished winter burning in March. Will try to burn 14, 000-acres in April, May and June depending on the drought conditions. Will bring in teams from Oregon to finish by July.

Champion:

Burned south side of virgin longleaf stand with good results. Would like to burn north side and the Cooley's Meadowrue site.

Northwest Florida Water Management District:

5,000 burned, have shut down since winter with plans for growing season burns in May and June. Depends on the weather and they are getting further behind and recently have cancelled burns due to poor conditions. NWFWMD gets a lot of help in burning from the John Fort group.

Blackwater River State Forest:

At last report, Blackwater had burned 25,000-acres of a planned 60,000-acres.

5) ***GCPEP Burn Team to review and possibly pursue funding from the National Turkey Federation. Team to include James Furman (Coordinator) from Eglin Air Force Base, Sonny Greene from Blackwater River State Forest, Pat Brinn or Michael Heard from Conecuh National Forest, and Steve Brown from the Northwest Florida Water Management District. Recommendations to be made by September 30, 1999.***

GCPEP was a part of an East Gulf Coastal Plain proposal to the Rodney Johnson/Katherine Ordway Stewarship Endowment. If funded, this proposal would initiate a fire team to lead or assist on priority sites in the GCPEP area. The proposal includes hiring a seasonal burn crew from SCA, AmeriCorps or interns. Urban Interface Burn. Volunteer and local fire services were able to provide many more people than DOF. Trained six certified burners and equipment to work with private landowners. Working with people in their community and working in a more efficient way. John Fort is looking for opportunities for the burn teams later in the spring when central and south Florida no longer need them. Equipment is possibly available on a volunteer basis to help out from Eglin. Geoff Babb is working with Randy to scale down project since less funding is available than expected. Steering Committee agreed to consider the possibility of a GCPEP burn team or a GCPEP Fire Resource Coordinator. Jim Murrian noted the successful interagency, cooperative fire team organized for the Lake Wales Ridge area. Both public and private funding was used for this fire team.

6) ***Project Director to approach Alabama and Florida Natural Heritage Inventory programs and DEP Ecosystem Management Coordinators for possibility of producing target maps for GCPEP.***

There is a need for a compelling map showing the GCPEP area and all partnership parcels of concern. The Steering Committee agreed that creating an up-to-date GCPEP map and completing a threats analysis would be beneficial. The data analysis is very helpful as a tool for identifying targets, threats and sources. Ecosystem management is fine-tuned with this type of detail. The main concerns are development pressures, smoke management, recreation, roads and population density. Using ArcView, public domain background coverages and cooperating efforts with other partners, the GCPEP staff will attempt to create the necessary maps.

Subcontractors may be necessary to create the coverages for targets, for pulling individual maps together and for incorporating Alabama.

7) ***Compile report on herbicide impacts on groundcover in the longleaf pine ecosystem. The Longleaf Pine Restoration Project at Eglin Air Force Base will complete by December 30, 1999.***

Herbicide Effects on Groundcover Vegetation in Southern Pinelands; A Literature Review - by Andrea Litt, Brenda Herring, and Louis Provencher of the Longleaf Pine Restoration Project at Eglin Air Force Base. The report by the Longleaf Pine Restoration Project was completed and discussed at the GCPEP Steering Committee Meeting. The Steering Committee has recognized the need for a review of herbicide impacts on groundcover, especially when considering restoration of longleaf pine sites. The report consists of a literature review of herbicide effects on groundcover species in southern pinelands. Included is relevant, peer-reviewed articles from journals, technical reports, theses and agency literature. Over 100 articles were scrutinized. After careful reading, 35 papers were retained that met the primary objective of the report. The studies varied enormously in quality. Beyond quality issues, the following additional challenges had to be overcome in order to pursue statistical analysis:

- Few studies share common treatments
- Few studies report on the same variables
- Some studies measure treatment effects from a few lumped variables (all herbaceous plants), whereas others sub-divide treatment effects at the species level.

The next steps of the study chose variables and treatments, decided how many to keep from each study, and then decided if there were enough studies to perform statistics on. To date, it has not been possible to gauge the prevalence of negative or positive effects because the data is too heterogeneous. General observations are that the positive effects of herbicides may be more common than negative ones when herbaceous plant species are grouped into life forms (forbs, grasses). This may occur if a dominant species such as broomsedge responds positively to herbicide application.

8) ***Complete assessment of aquatic systems status. Rick McWhite of Eglin Air Force Base will take the lead on developing a rapid assessment technique. Team to assist will include Kevin Leftwich of the National Forests in Alabama, Joe DeVivo of Eglin Air Force Base, and Stephanie Davis, the GCPEP Aquatic Specialist.***

The GCPEP Aquatic Specialist is preparing to conduct a rapid assessment of partner aquatic resources. She is working with the Eglin/USFWS Aquatic Ecologist on a GCPEP long term monitoring plan. This team also includes the Aquatic Specialists from Champion International and National Forests in Alabama. The Adopt-a-Stream method is used for quick assessment and DEP Biorecon for pre and post monitoring for restoration. The Aquatic Specialist will continue working with USFWS, DEP, FFWCC, on long-term monitoring, keeping abreast of regional monitoring and will meet with aquatic people from each partner to become more specific.

Additional Major Projects Selected. The Steering Committee decided to dedicate the remaining meeting time to selecting additional projects the partners could work on cooperatively. Projects were identified along with project leader(s).

1) GCPEP- Blackwater RCW translocation, cavity inserts and aggressive burning has succeeded in building the population from 15 to 24 families. Conecuh NF is up to 18 families, getting more areas ready for new centers of activities. Eglin has 5 – 6 donor birds available. Apalachicola will be translocating birds to Wakulla unit.
2) Research the possibility of a GCPEP Volunteer Coordinator-Project Administrator will work with Jim Murrian and Rick McWhite on this need. A proposal will be given to the Steering Committee.
3) GCPEP Prescribed Fire Resource Council. The Project Director will discuss this with the Fire Managers for each of the partners and other cooperators.
4) The Nature Conservancy needs to hire a dedicated land protection specialist for western Florida and south Alabama. TNC Protection staff has been reorganized. Special emphasis has been given to the GCPEP area with continued work on the Perdido Pitcher Plant Preserve and one specialist working on other GCPEP issues. Larry Ellis (TNC, AL) is leading the efforts with other TNC/AL staff on needs in South Alabama. Project Director put in 2-5 year plans the need to have additional protection help for GCPEP and surrounding lands. The Project Director will work with TNC Protection staff to discuss this need.
5) GCPEP to host an annual meeting to celebrate successes. For leaders of partner organizations, to bring community leaders, media event, successful partner projects, corporate management, resigning MOU, bring in new partners, fun time, celebrations and products out for leaders to see.
6) Expand GCPEP website and link to other partners and other agencies' web-sites. TNC/FL has now included GCPEP in their web-site. A meeting is scheduled for May with TNC PR departments to expand the web-page and to design and produce a GCPEP Brochure.
7) Partners to assist the Northwest Florida Water Management District with a prescribed burn on the Garcon Point Clark parcel.
8) Complete one cooperative GCPEP burn each year with locations suggested by the Steering Committee members.
9) Compile GCPEP success stories to be included in a quarterly newsletter internally circulated to the partners.
10) Find funding to conduct target surveys on partner lands. GCPEP Staff will pursue funding opportunities for terrestrial and aquatic targets surveys. Project Director and Aquatic Specialist met with USFWS Director from the Panama City office on GCPEP/USFWS cooperation and needs. Terrestrial and aquatic target surveys across GCPEP lands were highlighted as GCPEP needs. These are critical survey needs that we can always use help in finding funding sources to pursue.
11) Beaver, culvert blow-outs, stream systems, impoundments, culvert sizes, what to do, perforated culverts.
12) LLP Growth Yield & discuss with James the progress of research.

Partner Updates: Round Table Discussion for the partners to share concerns, successes, needs and suggestions.

Northwest Florida Water Management District

- Producing Public and Internal Reports
- Working on logo design for GCPEP
- Purchasing additional land parcels, including a critical parcel along the Yellow River

Conecuh National Forest:

- Roads and Trails Grant for County Roads
- 5-year Slash Pine Reforestation
- Environmental Impact Statement
- Looking for site preparation funding, possibly from American Forests
- AL Natural Heritage Program proposal for large watershed with rapid assessment of aquatics
- Research and analysis of planting native grasses on restoration areas

Eglin Air Force Base:

- Integrated Natural Resource Management Plan (INRM) issue driven workshops
- Barrier and Strategies Range and General Plan
- Conservation Action Plan for the Golf Course

Champion International Corporation.

- Champion International joined the GCPEP Aquatic Specialist on a tour of the watersheds within the "connector parcel" on February 3, looking for candidate streams to serve as possible benchmarks for water quality assessment studies
- Early planning beginning for a possible cooperative burn of (potential) flatwoods salamander habitat later this summer
- Discussions continued on formally establishing an agreement for the Florida Trails segment passing through the Champion "connector parcel"
- Completion of a Florida Endangered Species Booklet

Champion opened the company's forest management practices to scrutiny under the Sustainable Forestry Initiative (SFI) verification program. The SFI program is founded on twelve broad principles that, among other things, require prompt reforestation; provide for wildlife habitat; protect water quality; and protect sites of special significance. An Expert Review Panel comprised of some of the nation's leading natural resource professionals–six from academia; six from government and six from environmental groups oversees the program. The SFI program has been broadly acknowledged as an effective means of promoting responsible forest management. A team of five, including three resource specialists – a wildlife ecologist, silviculturist, and water quality specialist, conducted the week long review

The review team summarized their findings into two or three categories:

(1) Good Management Practices,
(2) Opportunities for Improvement, and, if it applies,
(3) Non-Conformance.

Champion sailed through with total conformance and few Opportunities for Improvement

After touring 400 miles of dirt roads each day for a week Champion sailed through with total Conformance and only a few Opportunities for Improvement.

Several of the members were unable to attend the Steering Committee meeting due to other critical commitments or agency/organization issues. With the increasingly involved schedules of our partner organizations, we want to continue to address the needs of the Steering Committee in the most effective and efficient way possible. Different options to better accommodate the busy schedules of the Steering Committee members were discussed including:

1. have one (1) day meetings, three (3) times a year, begin earlier & end later;
2. have the one day meetings at a centralized location;
3. have only one (1) of the quarterly meetings be a two (2) day meeting, which would include a tour of partner lands;
4. hold meetings Monday through Thursday, so travel is not on Friday night.

The meeting concluded with an evaluation and a discussion on possible dates for the next Steering Committee meeting. The date July 19, 2000 was selected and the location is to be announced.

CHAPTER 9. CONCLUSIONS

Summary of Findings

Over the past two years, the Gulf Coastal Plain Ecosystem Partnership has grown from a visionary concept to a successful landscape scale conservation project. The Partnership represents a strong commitment from the seven public and private landowners to further conservation in the area. The process of moving from a conceptual phase to a successful project is discussed in two stages, planning and implementation.

Planning. This innovative, voluntary Partnership was formalized in 1996 with the signing of a Memorandum of Understanding (MOU). Total lands included in the partnerhsip comprise an 845,800-acre landscape stretching from the Gulf of Mexico in the Florida Panhandle into Southern Alabama. The stated purpose of the MOU is to develop and implement a voluntary and cooperative stewardship strategy to sustain the long-term viability of native plants and animals, the integrity of ecosystems, the production of commodities and ecosystem services and the human communities that depend upon all of them. The partners agreed to the following primary goals to guide GCPEP:

- Develop a set of voluntary, cooperative conservation strategies and projects encompassing some or all of the 845,800 acres included in the GCPEP Memorandum of Understanding;
- Sustain and restore ecosystems occurring on GCPEP lands and the services they provide to local communities;
- Work within the constraints of the existing missions, management objectives and plans of each partner organization to find solutions to management challenges shared in common;
- Demonstrate how complex land management organizations with different missions can work cooperatively;
- Share lessons learned with other agencies, organizations and communities.

After reaching the milestone of the MOU, it was important for both planning and operations to bring together a group of managers representing each of the partners in GCPEP. This collective group is called the Steering Committee and serves to direct the operations of the Partnership. Each partner agency or organization chooses primary and secondary representatives for the Partnership. All decisions are reached by consensus.

One of the first priorities of the Steering Committee was to hire a GCPEP Project Director. Recruitment for the GCPEP Project Director began in March 1998. The Steering Committee, including Rick McWhite of Eglin, selected the final candidates and conducted the interviews. The Project Director, previously employed at Blackwater River State Forest as the Forest Resource Administrator, began work in May 1998. Other GCPEP staff, including a Project Administrator and an Aquatic Specialist, have been added to better address the needs of the Partnership, stakeholders and the surrounding communities. A Project Conservation Ecologist will soon be added to the staff to assist with conservation planning and monitoring for terrestrial targets.

The Partnership immediately began work on a GCPEP site conservation plan. GCPEP lands are clearly recognized as one of the most biologically significant landscapes in the United States. This significance is recognized in a recent book *entitled "Precious Heritage – The Status of Biodiversity in the United States"* (The Nature Conservancy and the Association For Biodiversity Information 2000). *"Precious Heritage"* identifies the Florida Panhandle as one of six national hot spots for diversity, taking into account both the richness and the relative rarity of species. This significance is also highlighted in a report completed for the Steering Committee by The Nature Conservancy entitled *"Conservation From An Ecoregional Perspective: The Biodiversity Significance Of The Gulf Coastal Plain Ecosystem Partnership"* (Hardesty 1999) and includes the following points:

- GCPEP comprises only 2% of the 42 million acre East Gulf Coastal Plain Ecoregion area, but includes 38% of its natural communities and 37% of its target species;
- The GCPEP landscape is considered one of the two most important landscapes in the Southeastern United States for conserving biodiversity;
- A national level analysis identified three GCPEP watersheds as critical hotspots for protecting at-risk fish and mussel species (The Nature Conservancy 1998b).

The development of sound conservation strategies depends upon completing a site conservation plan. The partners identified individual partner conservation objectives used to agree upon overall GCPEP conservation objectives. Planning and implementation has centered on these partners objectives, the top eight of which are listed below in priority order:

1. Conserve viable populations of target species
2. Introduce relatively natural fire regimes protecting key ecotypes
3. Protect urban interface and reduce fragmentation by use of conservation easements
4. Control erosion in ecologically sensitive areas
5. Manage recreation and public access
6. Increase communication, interaction and training among partners
7. Increase inventory and monitoring to further adaptive management
8. Increase public education and stakeholder involvement

Selection of targets is the first step in site conservation planning. At the site level, the appropriate choice of planning targets is the single most important step (Low 1998). The GCPEP Steering Committee agreed on an initial list of 8 conservation targets, which was then increased to 18 conservation targets (Chapter 6), representing both the species level and the community level. At the request of the Steering Committee, the GCPEP staff reviewed and then narrowed the target list to a final 16 conservation targets (Chapter 4). After selection of the targets, pertinent target ecological information was assembled, socioeconomic information was assessed and threats to the targets were identified. At most sites, one threat emerged as the "killer threat". Strategies were then selected to abate critical threats for the original eight conservation targets. Additional strategies for the remaining targets will be selected by the Steering Committee at meetings in the upcoming year. The response by GCPEP to these threats will very likely be the single most important factor affecting the long-term health of the conservation targets on GCPEP lands.

Even with the initial site conservation plan complete, the GCPEP Steering Committee recognized the importance of exporting the knowledge gained through the planning process to other stakeholders and landowners. Only then would GCPEP gain the support needed to abate the serous threats facing the conservation targets. Having GCPEP staff and partner staff conduct presentations, workshops, tours and work closely with the local media increased community support and involvement. The GCPEP staff has also become involved in community and business organizations to build support for GCPEP objectives, while advancing the recognition of threats and viable solutions to address them.

As mentioned in the Acknowledgements, many governmental and non-governmental agencies, and committed individuals have contributed time, expertise, funding and materials for support of the Gulf Coastal Plain Ecosystem Partnership. To list them all is difficult because they are so numerous and to leave even one out would be unfortunate. Everyone we have worked with has been very generous and helpful and we appreciate them all.

The GCPEP Steering Committee also recognized the significance of using and having access to the best science to assure proper management for the conservation targets. Increasing management and planning information is a critical step in any partnership. To properly address this issue, GCPEP staff completed information manuals for four of the Steering Committee meetings addressing partner needs and conservation targets (Appendices E, F, G and H). These manuals have proven to be important in providing scientific information to the partners and have led to improved land and water management.

Implementation. During and after completion of the site conservation plan, the GCPEP Steering Committee selected projects to implement objectives and strategies. These are detailed in the Steering Committee Meeting Summaries (Chapters 5-8). Successful implementation of projects is not only important in abating threats to conservation targets, but also in building trust within the Partnership and increasing community recognition. Two of the major challenges in a large, landscape-scale partnership are managing the wealth of worthwhile ideas and overcoming resource shortages to implement required strategies.

While considering projects, the GCPEP Steering Committee and Staff kept in mind objectives, threats, strategies and actions. Of course, the best planning will only lead to protection of conservation targets if the most critical projects are addressed. Major projects centered on the following:

- Red-cockaded woodpeckers
- Prescribed fire
- Land protection
- Recreation and public access management
- Watershed management
- Longleaf pine restoration
- Private landowners

Red-cockaded Woodpeckers. The red-cockaded woodpecker (RCW) is a federally listed species that requires large areas of high quality (primarily) longleaf pine habitat. Eglin has the fourth largest remaining population in the world. RCWs are found on 88% of the land area involved in the partnership. The first phase of the GCPEP cooperative work was to document the

current status of RCWs in the GCPEP landscape, use a spatially-explicit, demographic model to assess the extent to which each partners' RCW populations are connected to each of the others, assess which parts of the population are most susceptible to decline and then develop specific cooperative strategies and actions to mitigate the declines (Moranz and Hardesty 1998, Appendix B) Both monitoring and modeling indicated that Blackwater River State Forest populations were most vulnerable to decline and that the Blackwater and Conecuh National Forest populations were one and the same.

The model results, along with efforts from GCPEP partners and cooperators, led to a Division of Forestry RCW recovery plan. This plan is one of the first comprehensive RCW state management plans in the nation. The DOF also increased the local Ecology Unit staffing to assist in a more aggressive management for the RCW. To date, Eglin Air Force Base, Conecuh National Forest, Apalachicola National Forest, The Nature Conservancy, USFWS, FFWCC and the Francis M. Weston Audubon Society have all assisted in the recovery effort. The Audubon Society, through a cost share agreement between the USDA Forest Service and GCPEP, funded the first year RCW translocations at Blackwater. Initial success has continued to be high with 15 of the 31 cavity inserts now in use by RCW's. All five of the first year translocated females on Blackwater have been found and have paired with males. Recent efforts have centered on completion of the banding effort and an attempt to assure prescribed burning of all RCW foraging zones. Habitat improvement with cavity inserts has proved successful on Eglin, Conecuh and Blackwater (Appendix E). RCW populations are now increasing on all three partner lands containing RCW populations. Blackwater's population has increased from 15 to 24 families over the past two years. The RCW recovery effort stands as a very successful cooperative project for the GCPEP.

Prescribed Fire. Prescribed burning has been identified as a priority objective by GCPEP because of the significant role it plays in maintaining a healthy system for several different community types on GCPEP lands. On May 14, 1999 a GCPEP Cooperative Prescribed Burn was conducted on the Garcon Tract of the Garcon Point Water Management Area. The goal of the burn was to protect and enhance the ecological diversity of the wet prairie system. This prescribed burn would not have been possible without the efforts of the GCPEP, as the Northwest Florida Water Management District did not have the needed personnel or equipment to conduct the burn. Over 40 people participated in the burn, including personnel from The Nature Conservancy, Northwest Florida Water Management District, Florida Division of Forestry, Eglin Air Force Base, U.S. Bureau of Land Management, Florida Game & Freshwater Fish Commission, Office of Agricultural Law Enforcement, Avalon-Mulat Volunteer Fire Department and the Bagdad Volunteer Fire Department. The Project Director served as the Public Relations Manager for the burn, which offered an excellent opportunity to educate the public about GCPEP and prescribed burning. Information pertaining to the burn was broadcast on two local television stations and in the *Pensacola News Journal*. Additional cooperative burns have occurred on Eglin, NFWMD, and Champion lands.

Even with the successes of cooperative prescribed burns, prescribed burning is becoming increasingly difficult due to the rapid growth occurring in the area. A landscape disturbance model workshop was held June 1998 at Eglin with participation from other GCPEP partners and cooperators. The landscape disturbance model creates "movies" of expected landscape change over time resulting from different management scenarios. This innovative computer simulation

model graphically showed the results of various fire management rotations and highlighted the need for aggressive use of fire on partner lands (Peterson et al. 1998). Based on information from the model, Eglin managers increased their burn plan acreage to over 100,000 acres per year, representing a 3-year burn rotation. Conecuh National Forest is also on a 3-year burn rotation. Eglin and Conecuh, in particular, are emphasizing lightning season (summer) fire.

The Project Director led another landscape disturbance model workshop at Blackwater. This workshop was designed to allow for increased participation by Blackwater fire management supervisors. The model was modified to show effects of fire over time specific to the Blackwater landscape. Over recent years, the burn rotation at Blackwater has increased from a 2-3 year rotation to a 4-5 year rotation. The model showed that this would have serious negative environmental consequences. As a result, Blackwater managers are modifying their prescribed burning planning process to insure that acreage not burned each year is included in the next year's plan. A request has also been approved for a Division of Forestry helicopter to be stationed at the Crestview Work Station of Blackwater. This should greatly increase the capacity for prescribed burning at Blackwater.

Information and recommendations from these two workshops have been incorporated into draft management guidelines and plans, including development of a management plan for Blackwater and the continuing development of the next Eglin Integrated Natural Resources Management Plan. The landscape disturbance model and associated workshop proved instrumental in making important changes in partner prescribed burning programs. In addition, cooperative GCPEP burns have led to higher total prescribed burn acreage for the partners.

Land Protection. Incompatible development encroachment in and around partner lands is making land management and protection of conservation targets increasingly difficult. It is critical to have an expert land protection staff person available to move expediently on important land parcels when they come available. GCPEP staff have continued cooperative efforts between TNC, NWFWMD, Blackwater and Conecuh to pursue important land acquisitions along the Yellow River, Coldwater Creek and several in-holdings on Blackwater and Conecuh. Additional parcels of concern include Escribano Point on the west side of Eglin, a parcel on the Escambia River near the Alabama line, and lands bordering the Perdido Pitcher Plant Prairie. The 6,045-acre Coldwater Creek parcel was purchased by an Alabama landowner and is now for sale again. The DOF is now pursuing all parcels within this package that are in-holdings or that are along Coldwater Creek. TNC has offered assistance if needed.

The Project Director has also been active in moving forward the acquisition of Escribano Point (Appendix H) on the west side of Eglin. This large parcel of over 6,000-acres also borders Blackwater Bay and East Bay and harbors extensive wetlands, bayous and imperiled species and communities. Besides protecting critical habitat, the purchase of this parcel would provide an important buffer to both land management activities and the military mission at Eglin.

DEP is taking the lead on purchasing the Escribano Point property through the Florida Forever program. The largest landowner, Louisiana Development Corporation, is interested in selling and has been negotiating with DEP. TNC has offered assistance to DEP and has agreed to help in every way possible to assure this parcel is purchased and protected from development. Potential managers for this property include the NFWMD and the Yellow River Aquatic Preserves.

Recreation and Public Access. Controlling erosion in sensitive areas is a priority objective of GCPEP. However, public access is a very sensitive issue in the GCPEP area. Several of the partners have struggled for decades to find solutions to the problems surrounding roads, erosion and access. Using the Eglin Range road plan (Natural Resources Management Jackson Guard 1999) and planning process as a model, the Project Director presented a proposal to Blackwater River State Forest to complete an Environmental Assessment and Road Study. The study was suggested to be a cooperative effort involving Blackwater, surrounding communities, forest user groups, The Nature Conservancy and other agencies that could assist with expertise and/or funding. Suggested study issues included current road status, current and future road needs, environmental impacts and options for a forest road management plan. Working closely with Blackwater, the Project Director began pursuit of matching funds required for this priority project. The concept that started with discussions between the Project Director and managers at Blackwater River State Forest is to be implemented this year with funding from the Florida Division of Forestry. After completion of the study, the goal is to have a stakeholder supported public access plan balancing use and protection.

The GCPEP partners recognize the dual significance of compatible ecotourism for providing opportunities both for economic gain and for the public to learn about the natural world. Completion of the Florida National Scenic Trail is a significant recreation addition for the GCPEP area. The Project Director, Eglin, the Florida Trail Association (FTA) and the U.S. Forest Service continue with efforts to complete the Eglin portion of the Florida National Scenic Trail.

The Project Director applied for and successfully recruited the American Hiking Society Volunteer Vacation program to Eglin for one week during March 2000. The volunteers spent the week constructing seven miles of trail at Eglin, bringing the trail completed to date to an estimated 24 miles. The Volunteer Vacation was so successful that the majority of the participants volunteered to return to Eglin to assist in construction of trail bridges.

Community enthusiasm continues to grow with the local communities and the national trail community. This enthusiasm is evidenced by a recent article in Backpacker Magazine, a national trail and outdoor magazine that featured the Eglin Trail (Appendix G). In 1999 alone, over 3,600 hours were donated to completing the Eglin Trail and other connecting trails on Partnership lands. Currently, trails are being constructed or are in the planning stages on all contiguous partner lands.

Watershed Protection. The first GCPEP public education report focused on aquatic system threats in the Blackwater River watershed. Because of urban sprawl and increasing use of public lands and waters, freshwater systems in the GCPEP area are especially threatened. Sedimentation, nutrient loading, water withdrawals, water diversions, in-stream woody debris removal and landscape-level fragmentation of riparian buffers and corridors are the primary aquatic challenges.

"A Guide to Understanding & Protecting the Blackwater River Watershed", which was funded by TNC and the DEP, provides: 1) an explanation of how a watershed functions; 2) a brief history of the watershed; 3) list of important habitat, flora and fauna, 4) outline of challenges in the watershed; and 5) how the community can work together to protect and restore the Blackwater River. Emphasis was placed on solutions and good examples in the community.

The guide was initially mailed to community leaders and educators with a personal note from the Project Director about its purpose. A correlating poster and slide show will be used for community presentations.

Community response to the "*Guide*" has been more positive than expected with several requests for presentations and a high demand for the document. As a result of the report, the Santa Rosa County school system has requested the guide for use in all high school biology classes and a Santa Rosa County Commissioner has asked the Project Director to serve on the Santa Rosa County Stormwater Task Force. The guide was the subject of a recent news article in the *Pensacola News Journal.* The "Guide" provides much-needed education on aquatic systems that can be used in all GCPEP watersheds (Appendix H)

Another serious threat to watersheds in the GCPEP area is the removal of woody debris. In an attempt to abate this threat, the GCPEP Project Director served as a member of the Florida Department of Environmental Protection Deadhead Logging Technical Advisory Committee (DLTAC) representing TNC. In addition, the GCPEP Aquatic Specialist completed an exhaustive literature review.

The recovery of pre-cut, largely virgin timber logs from submerged land is commonly referred to as deadhead logging. These logs sank during transport down rivers early in the century. Because many of the rivers and creeks were channelized to move timbers and most of the old-growth trees in the river floodplains were cut, aquatic systems were subsequently starved of woody debris. In many places, the only large woody debris remaining was the sunken deadhead timber. While the river riparian areas continue to heal and recover with large trees, these are logs critical for habitat and structure. Deadheads are especially critical in rivers or creeks that are impacted by poor land management practices or are smothered with erosion.

By participating in the DLTAC, TNC was able to influence recommendations to the Florida Cabinet and also educate area citizens. In part due to TNC efforts, a temporary moratorium was placed on deadhead logging and the Blackwater River was removed from the Department of Environmental Protection permitted list. Now, deadhead removal from the Blackwater River can only occur with the permission of the Florida Division of Forestry. The majority of the recommendations of the DLTAC were the approved by the Florida Cabinet in April 2000 (Appendices G and H).

The Project Director and the Aquatic Specialist have also worked with the GCPEP partners and the DEP on restoration projects, aquatic monitoring, and bioassessment. An important GCPEP restoration project currently underway involves a stretch of a heavily used river road in Blackwater. The road runs through both Mare Creek and a small, unnamed branch. Driving through these creeks has made them wider and shallower downstream and the habitat is silted over. In order to reduce these impacts, a Bailey Bridge is being constructed across Mare Creek and a rock ford across the small branch. The Division of Forestry (DOF) is also rebuilding approximately ½ mile of the road, blocking off go-arounds, and closing vehicle access to roads that lead to sandbars. The Aquatic Specialist conducted pre-restoration biological and habitat evaluations on the two streams with the assistance of DEP and Blackwater staff. The sites will be re-sampled one year after the restoration to evaluate the impacts of the project. (Appendix H).

In addition to the need for aquatic restoration projects, the need also exists for aquatic classification locally. Aquatic classification is a tool that has the potential to aid in the identification of conservation sites. The classification framework can be used to describe and predict biological community diversity and distribution by spatially relating biotic classification units to an abiotic hierarchy. Aquatic classification of the waters in the GCPEP area would make it possible to identify a comprehensive set of ecologically defined conservation targets without having an extensive biological data set. The Aquatic Specialist recently participated in a meeting with the Freshwater Initiative (FWI) of TNC, USFWS, and FFWCC staff to discuss aquatic classification for North Florida. She will continue to work with this group as funding and staff become available to pursue aquatic classification for the GCPEP area waters.

Longleaf Pine Restoration. Millions of longleaf pine trees have been planted by the GCPEP partners in a very aggressive longleaf pine restoration effort. However, establishing the longleaf pine trees has proven to be the simple part of the restoration--groundcover restoration has been much more difficult. Much of the difficulty surrounding groundcover restoration centers on the lack of research, monitoring and information (Appendix D). It is known, though, that groundcover can be negatively impacted by both intensive site preparation and by excessive use of some herbicides. Negative impacts from herbicides seem to be primarily from application methods and formulations. Realizing the significance of the groundcover to conservation targets and to the continued use of prescribed fire, the GCPEP Steering Committee requested a report on herbicide impacts on groundcover. The Nature Conservancy conducted a literature review of herbicide effects on groundcover species in southern pinelands (Appendices G and H). Results from the study showed that despite widespread herbicide use, effects on groundcover vegetation are not well understood. The review of 21 studies pointed out that woody cover generally declined with herbicide applications while herbaceous cover results were mixed. Several species of concern declined with herbicide use, but the results on wiregrass were contradictory. The review clearly indicates that additional research using proper experimental design needs to be conducted. Especially on public lands, caution should be used when using herbicides due to the tremendous groundcover diversity and the important role it plays in the longleaf pine ecosystem.

Working with Private Landowners. The single most important landscape linkage in the region is the 7,550-acre parcel owned by Champion International connecting the 464,000-acre Eglin AFB to the 273,000-acre Blackwater River State Forest-Conecuh National Forest landscape. To succeed in restoring the longleaf pine ecosystem across the southeastern United States, it is crucial to have success stories showing public and private landowners working together cooperatively. This is particularly true in the GCPEP landscape area. The first objective for the Champion connector was to have a successful Partnership project involving Champion and other partners. The project was an erosion control effort on the connector parcel involving Champion, Florida Department of Transportation (DOT), The Nature Conservancy, Blackwater River State Forest, Eglin Air Force Base and the Northwest Florida Water Management District. The initial phase of halting erosional input was completed quickly. Under the direction of the Project Director, a restoration effort was completed on the site that included planting of native trees and shrubs and cleanup of illegally dumped materials. The restoration effort was centered around two steephead creeks with a population of the rare Florida bog frog. The Florida bog

frog is found only on a small area on Eglin Air Force Base and Champion International. Twenty-two people participated in the effort including community volunteers.

Several meetings have also been conducted with Champion managers on setting priorities and objectives for the connector parcel. It was agreed that the first step would be a complete biological survey of the entire Champion connector parcel. This has proven to be a very difficult task, as the GCPEP staff has been unable to locate the funding necessary to conduct the needed surveys. However, the GCPEP Aquatic Specialist is continuing to work closely with the Florida Department of Environmental Protection to survey and monitor creeks on the Champion connector parcel. The GCPEP staff is also pursuing funding to start a Florida Adopt-a-Stream program, making use of the area's willing volunteers.

Final Summary. Many other successful projects have been initiated and/or completed by GCPEP. The Partnership stands as an example of what can be accomplished when people work together. The partners accomplish the majority of the on-the-ground work required to maintain healthy land and water, but a dedicated Partnership staff is vital to move the Partnership forward. The assistance and continuity provided by the GCPEP staff has been instrumental in building this successful partnership.

REFERENCES

Alabama Natural Heritage Program (AHNP). April 15, 1999. Elements occurring in the Conecuh National Forest (including Blue Spring W.M.A.), Alabama. Data from the Biological Conservation Database of the Alabama Natural Heritage Program, Montgomery, AL.

Bailey, R.G. 1995. Description of the ecoregions of the United States, 2d ed. rev. and expanded (1st ed. 1980). Misc. Publ. No. 1391 (rev.). USDA Forest Service, Washington, DC.

Brown, Mark J. 1996. Forest statistics for Florida, 1995. Southern Research Station, Asheville, NC.

Brown, Mark J. 1988. Forest statistics for Northwest Florida, 1987. Southern Research Station, Asheville, NC.

Bureau of Economic and Business Research. 1991. 1991 Florida Statistical Abstract. Bureau of Economic and Business Research, University of Florida. Gainesville, FL.

Bureau of Economic and Business Research. 1997. 1997 Florida Statistical Abstract. Bureau of Economic and Business Research, University of Florida. Gainesville, FL.

Bureau of Labor Statistics. 1999. *Bureau of Labor Statistics data*, [online] one page data table. Available URL: http//stats.bls.gov/datahome.htm [1999, May 27].

Center for Business and Economic Research. 1997. Economic Abstract of Alabama. Center for Business and Economic Research, University of Alabama. Tuscaloosa, AL.

Center for Compatible Economic Development. 1999. Efroymson Community-based Conservation Fellowship Program: Identifying and Ranking Systems, Stresses & Sources. The Nature Conservancy, Arlington, VA.

Conant, R. and J.T. Collins. A field guide to reptiles and amphibians, eastern and central North America. Houghton Mifflin Co. Boston, MA.

Conecuh National Forest, 1999. Data on rare elements at Conecuh. Conecuh National Forest, Andulusia, AL.

Deyrup, M. and R. Franz. 1994. Rare and endangered biota of Florida: volume IV, invertebrates. University Press of Florida, Gainesville, FL.

East Gulf Coastal Plain Core Team. 1999. East Gulf Coastal Plain ecoregional plan. The Nature Conservancy, Southern Conservation Science Support Office, Chapel Hill, NC.

East Gulf Coastal Plain Core Team. 1999. East Gulf Coastal Plain ecoregional plan. Southern Conservation Science Office, The Nature Conservancy, Chapel Hill, NC.

Florida Natural Areas Inventory (FNAI). 1999. Occurrence records currently in the FNAI database. Florida Natural Areas Inventory, Tallahassee, FL.

Florida Natural Areas Inventory (FNAI) and Florida Department of Natural Resources (DEP). 1990. Guide to the Natural Communities of Florida, Tallahassee, FL.

Flowers, R.W. 1997. An invertebrate survey of Hulburt Field, FL, with special reference to species of special concern. Florida A&M University, Tallahassee.

Hardesty, J.L. and R.A. Moranz. 1999. Longleaf pine ecosystem restoration in northwest Florida sandhills: Issues and recommendations. The Nature Conservancy, Gainesville, FL.

Hardesty, J.L., R.A. Moranz, S.P. Woodward, and V.S. Compton. 1999. The Gulf Coastal Plain Ecosystem Partnership: An assessment of conservation opportunities. The Nature Conservancy, Gainesville, FL.

Hawkins, R. and S. Kastro. 1999. Job quality and economic distress of west Florida, [online] four-page article. Available URL: http://www.haas.uwf.edu/indicators/income.htm.

Jelks, H.L. and S.K. Alam. 1998. Recovery plan for Okaloosa darter, *Etheostoma okaloosae.* U.S. Fish and Wildlife Service. Atlanta, GA.

Kindell, C.E., B.J. Herring, C. Nordman, J. Jensen, A.R. Schotz, L.G. Chafin. 1997. Natural community survey of Eglin Air Force Base, 1993-1996: Final report. Florida Natural Areas Inventory, Tallahassee, FL.

Land Acquisition Advisory Council (LAAC) and Florida Natural Areas Inventory (FNAI). August 1992. Project Assessment: Yellow River Ravines Conservation and Recreation Lands Project, Pensacola, FL

Low, G. 1998. Landscape-scale, community-based conservation. The Nature Conservancy, Arlington, VA.

Marois, K.C. 1998. Plants and lichens, vertebrates, invertebrates and natural communities tracked by Florida Natural Areas Inventory. Florida Natural Areas Inventory, Tallahassee, FL.

Master, L.L., S.R. Flack, and B.A. Stein, eds. 1998. Rivers of life: critical watersheds for protecting freshwater biodiversity. The Nature Conservancy, Arlington, VA.

Moler, P.E. 1992. Rare and endangered biota of Florida. University Press of Florida, Gainesville, FL.

Moranz, R.A., and J.L. Hardesty. 1998. Adaptive management of red-cockaded woodpeckers in northwest Florida: Progress and perspectives. The Nature Conservancy, Gainesville, FL.

Natural Resources Management Jackson Guard. 1999. Integrated Natural Resources Transitional Plan. Eglin Air Force Base, FL.

Noss, R.F. 1990. Indicators for monitoring biological diversity: a hierarchical approach. Conservation Biology 4:355-364.

Obersholster, Chris. The Nature Conservancy, Birmingham, AL. Personal communication.

Peterson, G., J. L. Hardesty and D. Gordon. 1998. Development of a spatial forest dynamics-fire model for a sandhill matrix ecosystem in northwest Florida (Eglin Air Force Base). The Nature Conservancy, Gainesville, FL.

Poiani, K.A., B.D. Richter, M.G. Anderson and H.E. Richter. 2000. Biodiversity conservation at multiple scales. Bioscience 50:133-146.

Printiss, D.J. and D.L. Hipes. 1999. Rare amphibian and reptile survey of Eglin Air Force Base, Florida, Final Report. Florida Natural Areas Inventory, Tallahassee, FL.

Santa Rosa County Community Planning. 1998. Comparison table: existing and current land use by land use category and percentage of change. Zoning and Development Division, Santa Rosa County Community Planning. Milton, FL.

Sheehan, James. Tall Timbers Research Station, Tallahassee, FL. Personal communication.

The Nature Conservancy and Association for Biodiversity Information. 2000. Precious Heritage, the status of biodiversity in the United States. Oxford Press. New York, NY.

The Nature Conservancy. 1997. Designing a Geography of Hope: Guidelines for Ecoregion-based Conservation in The Nature Conservancy. Arlington, VA.

The Nature Conservancy. 1998a. Landscape-scale, Community-based Conservation: A Practitioner's Handbook. Arlington, VA.

The Nature Conservancy. 1998b. Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity. Arlington, VA.

The Nature Conservancy. 1998c. An Approach for Conserving Biodiversity at Portfolio Sites: Site Conservation Planning. Arlington, VA.

Thorpe, P., R. Barel, P. Ryan, K. Albertson, T. Pratt and D. Cairns. 1997. The Pensacola bay system surface water improvement and management plan. Northwest Florida Water Management District. Tallahassee, FL.

U.S. Bureau of the Census. 1997. USA Counties, [CD-ROM]. Available: U.S. Bureau of the Census, Washington, DC.

U.S. Bureau of the Census. 1998. Estimates of the population of counties. Population Estimates Program, Washington, DC.

Wolfe, S.H., J.A. Reidenauer and D.B. Means. 1998. An ecological characterization of the Florida panhandle. U.S. Department of the Interior, Washington, DC

Vissage, John S. 1991. Forest statistics for Alabama counties-1990. U.S. Dept. of Agriculture, Forest Service, Southern Forest Experimental Station. New Orleans, LA.

APPENDIX

A. A Guide to Understanding and Protecting the Blackwater River Watershed

B. Adaptive Management of Red-Cockaded Woodpeckers in Northwest Florida: Progress and Perspectives

C. Development of a Spatial Forest Dynamics-Fire Model for a Sandhill Matrix Ecosystem In Northwest Florida (Eglin Air Force Base)

D. Longleaf Pine Ecosystem Restoration in Northwest Florida Sandhills: Issues and Recommendations

E. Steering Committee Manual # 1.
    - Groundcover Restoration
    - Exotics
    - Longleaf Pine Genetics
    - Endangered Species
    - Prescribed Burning
    - Aquatics, Wetlands
    - Game Species
    - General

F. Steering Committee Manual # 2.
    - Isolated Wetlands
    - Citronelle Ponds
    - Amphibians
    - Flatwoods Salamander
    - Other Amphibians
    - Blackwater River
    - Aquatic Insects
    - General

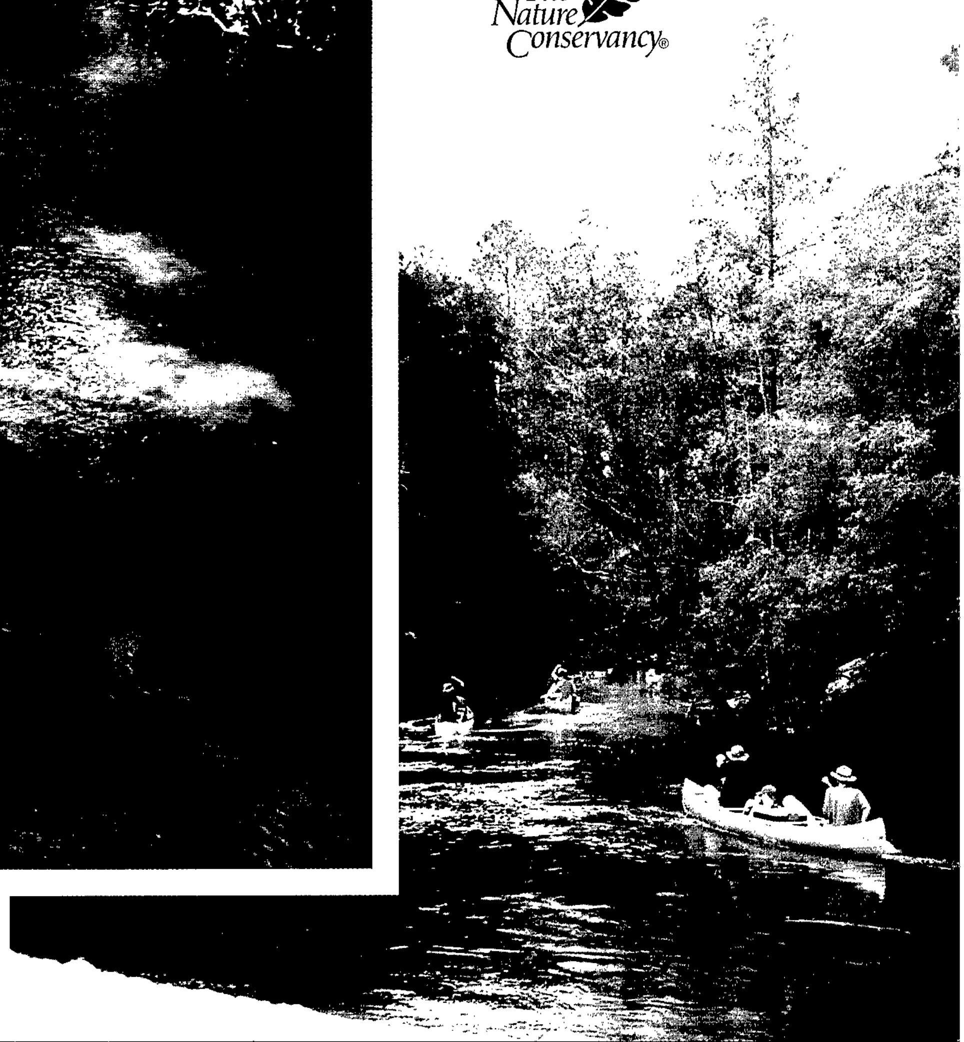
G. Steering Committee Manual # 3.
    - Public Education
    - Aquatic Woody Debris
    - Flatwoods Salamander
    - Herbicides
    - Longleaf Allliance
    - General

H. Steering Committee Manual # 4.
    - Conservation Planning
    - Herbicides
    - Gulf Sturgeon
    - Aquatic Woody Debris
    - Coastal Plain Streams
    - Biological Monitoring
    - Amphibians
    - News Articles

A Guide to Understanding & Protecting the Blackwater River Watershed

APPENDIX A.

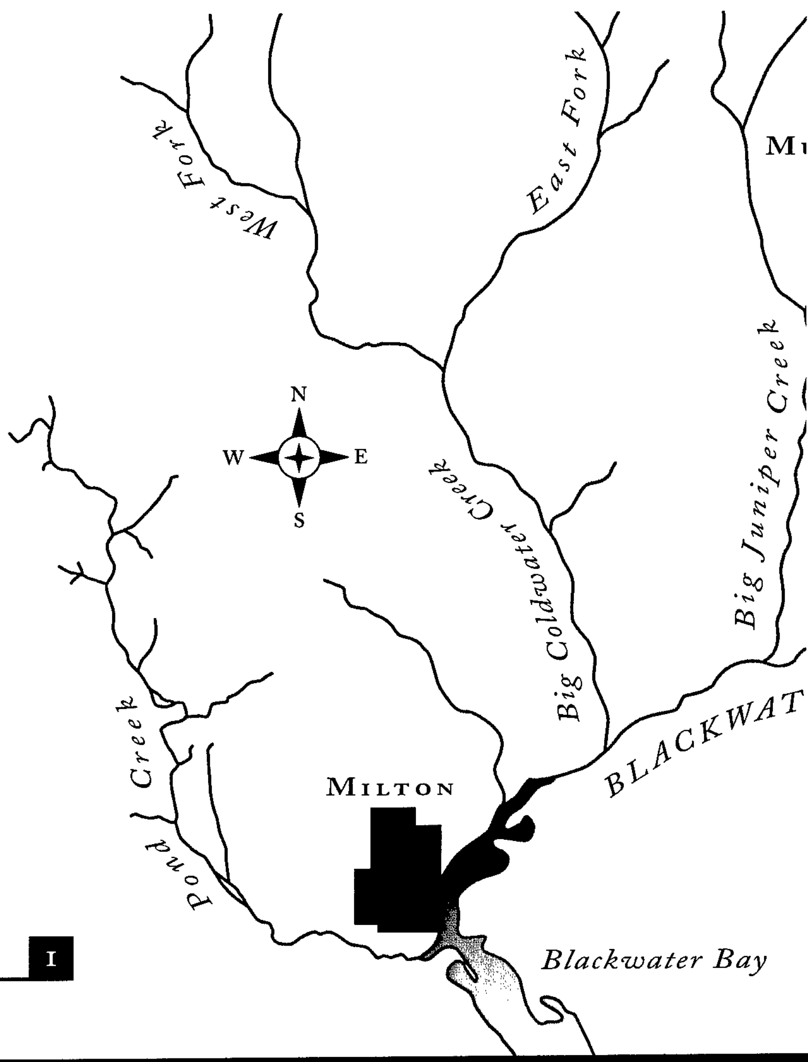
The Nature Conservancy®



A Guide to Understanding and Protecting the Blackwater River Watershed

The Blackwater River is prized for its tea-colored waters, white sandbars and recreational opportunities. Residents and visitors alike enjoy canoeing, fishing, hunting and wildlife viewing along the Blackwater River.

However, as the river and its surrounding lands become more popular, the Blackwater River watershed will face pressures that could limit its ability to provide the resources that we depend on for our recreation and livelihood. To address these and other challenges, we must understand the river's history, its vegetation and wildlife, and what we can do to protect it.



The Blackwater River and its Watershed

The water in the Blackwater River is part of a large natural process called the water cycle. As the river flows toward the Gulf of Mexico, water evaporates from its surface and surrounding forests and condenses into rain clouds that return the water to the Earth's surface as rain. The falling rain eventually flows back into the river, and the water cycle continues as water again begins to evaporate.

All of the land that drains into the Blackwater River makes up its watershed. Approximately 860 square miles of land comprise the Blackwater River watershed, including the land area of its three major tributaries — Big Juniper Creek, Big Coldwater Creek and Pond Creek.

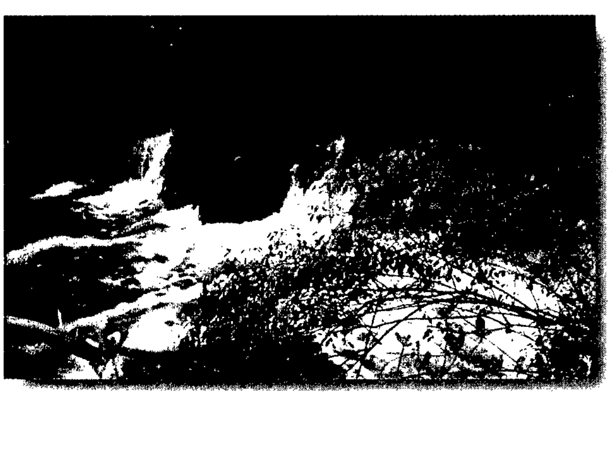
The river mainly flows through protected forests including Conecuh National Forest, Blackwater River State Forest and Blackwater River State Park. However, pockets of managed agricultural and silvicultural lands and areas of urban and suburban development, including the communities of Bradley, Baker, Jay, Holt, Harold, Milton and Munson, are also located in the river's watershed. All activities within this large area affect the Blackwater River. Therefore, the health of the river depends on how these lands are managed.

A Brief History of the Blackwater River Watershed

Logging has played a key role in the history of the Blackwater River watershed. Beginning in the 1830s, lumbermen harvested pine, cypress and juniper from the lands surrounding the Blackwater River. By the late 1800s, the sawmills around Blackwater Bay were the largest in Florida, producing millions of board feet of lumber for the world market.

Before logging railroads arrived in northwest Florida in the 1880s, all logs were floated down the river to mills in Milton and Bagdad. Some of the logs, called sinkers or deadheads, sank in the river on the way to the mills and are still there. To make way for the logs to float down the river, loggers removed most of the natural woody debris from the river. Today, the deadhead logs provide important structure and habitat that was lost when the river was de-snagged.

Logging continued until the timber supply was exhausted in the early 1900s. At this point, logging had left the watershed denuded of trees and some of the watershed's streams channelized.



Rafting logs on the Blackwater River.

When much of the Blackwater River watershed came into public ownership in the 1930s, replanting the forests became a top priority. In 1936, the area surrounding the headwaters of the Blackwater River in Alabama became the Conecuh National Forest. The federal government acquired the land around the Blackwater River in Florida in the early 1930s for a land-use project. In 1938, the Florida Board of Forestry and the United States Department of Agriculture executed an agreement for cooperative land management. Later, in 1955, the government deeded the forest to the Florida Board of Forestry (now the Florida Division of Forestry), establishing the Blackwater River State Forest.

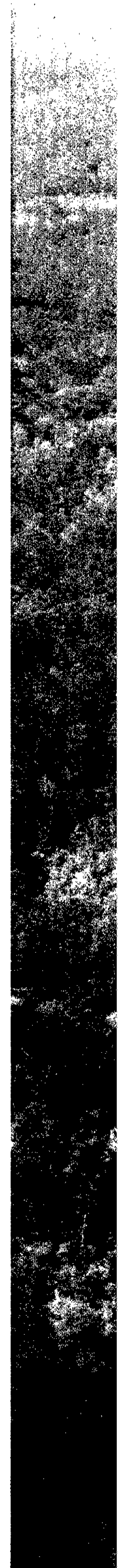
These public lands are currently managed for multiple uses, including recreation, timber production, watershed protection, wildlife management and recovery of endangered plant and animal species. Many private landowners have also been good land stewards and have re-grown extensive bottomland hardwood and upland pine forests. Continued land management on these private and public lands is the best investment possible for the future health of the Blackwater River watershed.

Habitat and Water Quality

The Blackwater River is one of the best remaining examples of a shifting, sand-bottomed river in the United States and is located within one of the largest remaining contiguous areas of longleaf pine forest in the country. The upper reaches of the Blackwater are swift and shallow with sparse aquatic vegetation, clean sand, woody debris and steep banks covered with grasses and trees. The lower river channel varies in depth from 10 to 60 feet and is influenced by ocean tides with moderate currents. Aquatic vegetation is much more common along the lower river, especially in the freshwater and brackish basins.

Many plants and animals depend on the Blackwater River and its tributaries, and each of these organisms has unique habitat and water-quality requirements. The kinds of aquatic organisms that are found in the river are determined by environmental conditions such as streambed type, water quality, flow velocity and streamside vegetation. For example, burrowing mayflies use the river's shifting sands for shelter. Fish find cover in deep pools and woody snags, while stoneflies and dobsonflies attach to the woody debris on the river bottom for stability.

When these environmental factors are changed, sometimes the needs of certain aquatic organisms may no longer be met. Sediment, toxic chemicals and nutrient enrichment can interfere with the everyday processes of aquatic organisms, such as breathing, feeding and breeding, and may cause population decreases or extinction. To detect changes in habitat and water quality, it is important to monitor the Blackwater River and its creeks. Without monitoring, environmental changes that harm plants and animals are not always obvious because the damage may have occurred years ago, or because the changes may occur slowly over a period of time.



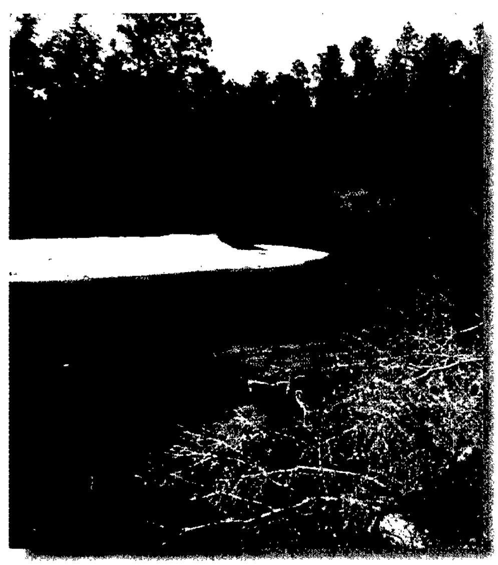
The Blackwater River's natural tea-colored waters are laden with organic acids that leach from leaves and needles in surrounding swamps.

Coldwater Creek

Streamside Vegetation

Well-vegetated stream banks are important parts of a healthy river system. Forest buffers have an incredible ability to filter out sediment and nutrients from runoff. As the runoff reaches grasses, roots and leaves on the forest floor, it slows, allowing time for the vegetation to absorb nitrogen and phosphorus and trap sediment. The roots of streamside trees, shrubs and grasses also help to maintain stable stream banks by protecting and reinforcing them.

Streamside forests serve as a source of woody debris for the Blackwater River and its streams. The large woody debris traps finer materials, such as leaves and grasses, that provide food for many aquatic organisms. Woody material, including logs, also helps to stabilize the sandy river bottom and provides habitat for many stream animals. In some areas, streamside vegetation is the best remaining habitat, food source and breeding area for wildlife. These streamside forests also serve as wildlife corridors for many migratory animals.



Well-vegetated stream banks along Juniper Creek.

The Blackwater River Watershed is home to many species of plants and animals that are considered rare, threatened or endangered. These include:

Fish

Blackmouth shiner
Gulf sturgeon
Blacktip shiner
Florida chub

Amphibians

Pine barrens treefrog
Dusky gopher frog
Tiger salamander

Reptiles

Eastern indigo snake
Gopher tortoise
Alligator snapping turtle
Florida pine snake

Aquatic Insects

Blue sand-river mayfly
Dolania mayfly
Diminutive clubtail
Townes' clubtail
Peters' little sister sedge
Zigzag Blackwater River caddisfly
Say's spiketail dragonfly

Birds

Bachman's sparrow
Red-cockaded woodpecker

Plants

Piedmont jointgrass
Panhandle lily
Hummingbird flower
Chapman's butterwort
Small-flowered meadowbeauty
White-top pitcher plant
Wherry's sweet pitcher plant
Chaffseed
Chapman's yellow-eyed grass
Mountain laurel

The diversity of aquatic insects can be seen in the following list of aquatic insects identified by William Peters of Florida A & M University in 1979. This list represents the best survey information available to date.

- 33 species of dragonflies and damselflies
- 42 species of mayflies
- 21 species of stoneflies
- 24 species of caddisflies
- 3 species of dobsonflies and fishflies
- 12 species of true water bugs
- 20 species of beetles
- 52 genera of midges

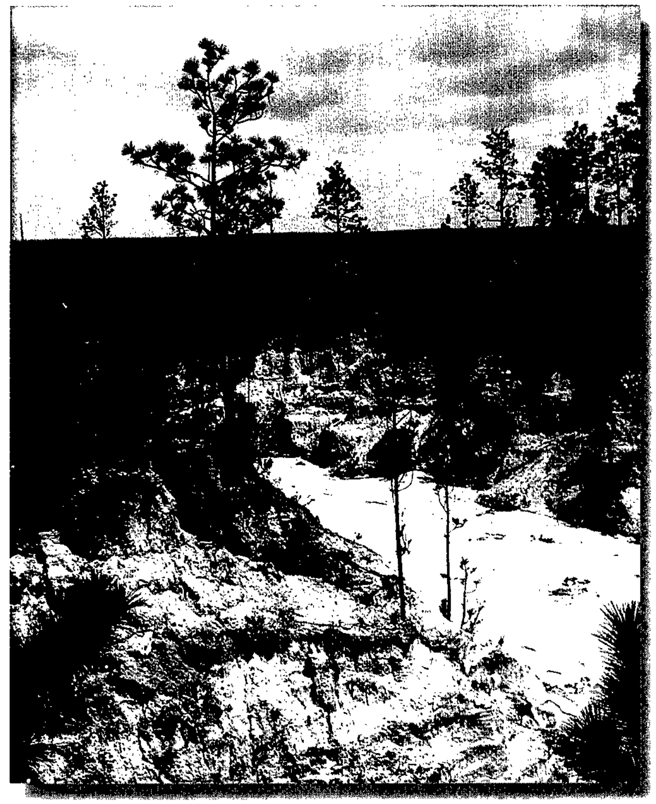
Challenges for the Blackwater River Watershed

Accelerated Erosion

While erosion is a natural process, human activities can accelerate it far beyond normal rates. The combination of steep slope, high intensity rainstorms, and deep, sandy soils make the Blackwater River watershed especially vulnerable to accelerated erosion and sedimentation. Accelerated erosion in the watershed is associated mainly with poor building construction and road maintenance practices, the large number of vehicular access points to rivers and streams, and the removal of streamside vegetation.

Excess sediment is a major concern in the Blackwater River. When excess sand and clay from roads, construction sites, timber lands, pastures and croplands drain into the river, they can smother the entire system by covering food sources and habitat and interfering with respiratory systems of fish and aquatic invertebrates.

Silt and sediment can also disrupt the breeding cycles of bottom-dwelling stream animals by covering breeding sites and smothering developing eggs and young on the stream bottom. This in turn affects other fish and wildlife that feed on them.



Above: Sediment from this large gully is filling the Blackwater River. Below this spot the river was once 4 to 8 feet deep. In places it is now only a few inches deep.

Bottom left: This road used to be at the level of the trees along its side. Note how much of it has eroded. Sediment from this road is washing into a creek that feeds the Blackwater River.

Below: A mud hole on a road that runs along the edge of the Blackwater River. During a flood it is a source of heavy sediment into the river.

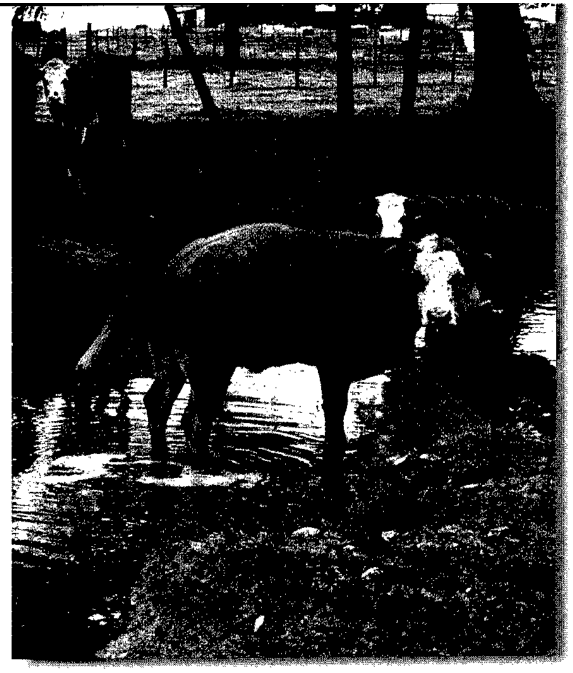
Removal of Woody Debris

Often wood is the only stable material in sand-bottomed rivers like the Blackwater River. This woody debris helps to stabilize the sandy river bottom and its banks by slowing the river's current and erosive power. Fish use the woody snags for shelter, and many aquatic insects attach to the wood to filter food from the water or to scrape food from the surface of the wood.

Logs that sank in the river during the logging operations of the 1800s also provide structure and replace the woody snags that loggers removed to make way for logging rafts over a century ago.

The removal of these deadhead logs was recently legalized. Removing wood from the river may have far-reaching negative impacts on both aquatic organisms and the structure of the river.

Rope marks deadhead log for removal.



Many farmers fence out cattle to prevent erosion, nutrient and bacteria inputs.

Nutrient Enrichment

Excessive nutrients, in the form of nitrogen and phosphorus, can disrupt the balance of aquatic systems. Nutrient additions act as a source of food for algae and can result in unnaturally large algal blooms. In turn, the algal blooms block sunlight from submerged aquatic plants, smother bottom-dwelling organisms and reduce dissolved oxygen levels in the water. Low oxygen levels kill fish and stream insects. Sources of excess nutrients in the Blackwater River watershed include livestock waste, septic system leakage and excessive fertilizers from lawns, crops and fishponds.

Elevated Bacterial Levels

Water bacteria originating from human, wildlife or livestock waste is a major health concern. Septic tanks and livestock near streams are the main sources of bacteria in the Blackwater River. It is unsafe for people to go swimming and boating in some of the river's tributaries when bacterial levels are high.

Flow Alteration

Floods are a natural part of the Blackwater River system. During floods, the river is connected with its adjoining floodplain. Many fish, amphibians and reptiles need to access the floodplain to breed. Woody debris from the floodplain provides habitat and stability to the river, and leaves and grasses are important food sources for aquatic organisms.

Improperly placed culverts, roads and bridges can alter the natural flow of a river system and interfere with the floodplain-river connection. These structures can act as dams and flood an area. Many plants and animals cannot survive in the altered environment of the flooded area. Removing trees for buildings and clearings in the floodplain also can disrupt natural flood patterns because trees slow flood waters.

Litter and Dumping

Tons of garbage are dumped in the Blackwater River watershed each year. These sites are expensive to clean up, and pollutants from garbage can harm wildlife and contaminate ground water.

Decreased Water Quantity

The expanding population of northwest Florida has increased the demand for water. Coastal communities are looking inland for additional water sources in an attempt to alleviate pressures on the aquifer and avoid saltwater intrusion caused by over-pumping.

To meet the water demands of the coast, large capacity well fields have been proposed in northern parts of Santa Rosa County. These well fields could decrease flows in the river. Decreases in river flows could hurt the plants and animals of the river and ultimately damage the entire Blackwater River ecosystem.

Another concern related to large capacity well fields is the possibility of ground water contamination. Deep holes in the Blackwater River trap saltwater that moves in from the Gulf. These holes could be a source of contamination of the surrounding ground water if large wells are located near the river and pumped heavily.

Toxic Chemicals

Chemicals, such as petroleum products and pesticides, can harm rivers and streams. Although individual sources may be small, cumulatively these poisons can combine to harm aquatic organisms. This pollution also causes health problems in humans who eat fish that have been exposed to chemicals.

Working Together to Protect the Blackwater River Watershed

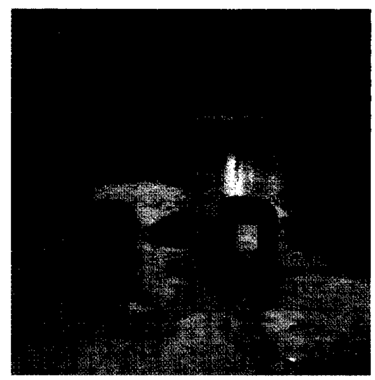
Paving this road and grassing its ditches has eliminated a substantial source of clay into the Blackwater River.

In order to keep the Blackwater River healthy, we must reduce habitat and water quality degradation by continually improving our land-use practices. Only then will we be able to ensure that the Blackwater River will be both productive and healthy for future generations.

By working together we can protect the Blackwater River watershed. Listed below are steps we can take to restore and protect the Blackwater system.

PAVE AND IMPROVE ROADS WHERE APPROPRIATE. In some cases, the most effective way to reduce erosion from a road is to pave it and vegetate its roadsides.

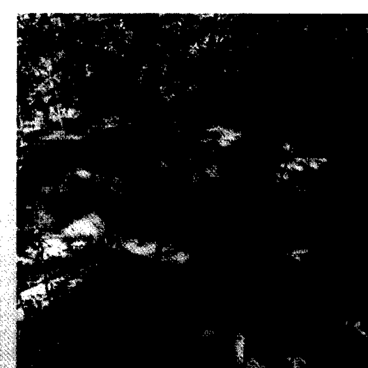
CLOSE ROADS AND CLAY PITS THAT ARE BADLY ERODED OR TOO CLOSE TO THE RIVER AND ESTABLISH MAINTENANCE STANDARDS FOR ROADS THAT REMAIN OPEN. Roads and clay pits are the main conduits of silt and sediment to the river. Closing severely degraded roads and properly maintaining open roads will reduce sedimentation in the river. Land managers, local citizens and forest users need to work together to prioritize roads and clay pits to be restored or closed.



Sediment from a road had choked this small stream. After restoration and improvements, such as this wooden bridge and trail, the stream came back to life.

EVALUATE CULVERTS, ROADS AND BRIDGES AND REPLACE WITH STRUCTURES THAT ALLOW NATURAL FLOW. Building structures that span the floodplain will reduce environmental damage and cut down the costs of flood damage.

ENFORCE STORM-WATER RUNOFF REGULATIONS FOR ROAD AND BUILDING CONSTRUCTION SITES. These regulations require the use of silt fences, retention ponds and buffer areas that keep silt and sediment out of waterways.



Create streamside buffer zone requirements. Streamside vegetation stabilizes banks, reduces erosion, filters nutrients and contaminants, and provides habitat. Steep, sandy slopes should receive priority for buffer protection.

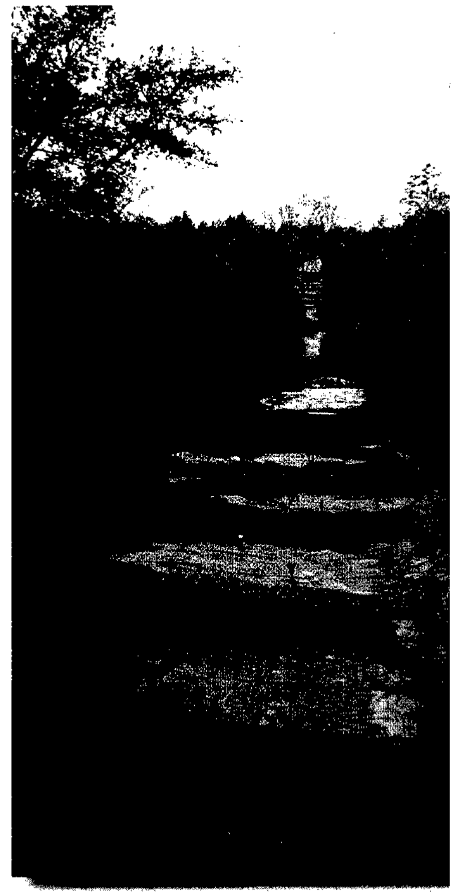
Encourage programs that provide funding for BMPs on pastures and croplands. Best management practices (BMPs), such as fencing in livestock and planting vegetation buffers near streams, will reduce sediment, nutrient and bacterial levels in waterways.

Encourage voluntary BMPs on private lands. BMPs that leave streamside vegetation buffers and minimize stream crossings help control erosion.

Promote widespread education about septic tanks and support the extension of city water and sewer lines wherever feasible. Leakage from improperly maintained septic tanks is a source of both nutrients and bacteria. As the population in the watershed grows, leakage from septic tanks could become a major water quality problem.

Discourage building and farming in the floodplain. It is better for the river system and residents near the river if the floodplain is forested because the floodplain acts as a sponge during flood periods by releasing flood waters slowly.

Require a thorough environmental impact study before allowing the removal of snags or deadhead logs. The removal of wood from streams destroys critical habitat and can destabilize the system. Because the Blackwater River system suffers from sedimentation and accelerated erosion, woody debris is especially critical.



The sediment from this road had completely filled in a small creek. Hay bales and newly planted trees help control erosion.

Provide an adequate number of trash cans at boat launches and bridges and increase enforcement for littering and illegal dumping. People are more likely to dispose of their trash if educated and supplied with disposal containers. Fines work only if they are enforced.

Seek funds to build more wooden canoe launches. Given the volume of canoe traffic on the Blackwater River, one of the most effective ways to help reduce streamside erosion is to provide wooden canoe ramps.

Support land managers as they strive to balance adequate public access with the protection of natural resources. Land managers often have to make difficult decisions. Knowing that community leaders support them can make enforcement easier.

Develop and implement a regional plan to address water quantity issues and establish a minimum flow level for the river. Demands of the coastal population should not supercede the needs of the Blackwater River and the citizens of its watershed. To best manage the water resources of northwest Florida, a long-term, regional approach must be taken.

Ensure adequate funding for enforcement, restoration and pollution source identification. It is up to community leaders to support the request for funding needed to restore and protect the Blackwater River watershed. Restoration projects should include stream bank re-vegetation, closing or paving eroded roads and replacing culverts with bridges or low water crossings. Adequate staff to enforce laws and regulations is essential.

Provide funds to monitor aquatic systems. Monitoring provides the data necessary to evaluate the effectiveness of various restoration techniques, the condition of aquatic plants and animals, and water quality.

Support organizations that focus attention on watershed issues. Currently, the Gulf Coastal Plain Ecosystem Partnership, the Pensacola Bay Ecosystem Management Advisory Council, the Bay Area Resource Council and the West Florida Regional Planning Council are pursuing funding for restoration, resource protection and education.

Support organizations and partnerships that are working to abate threats to the Blackwater River watershed. (See page 17.)

Wooden canoe launch on the Blackwater River.

Hummingbird flower.

A Step in the Right Direction

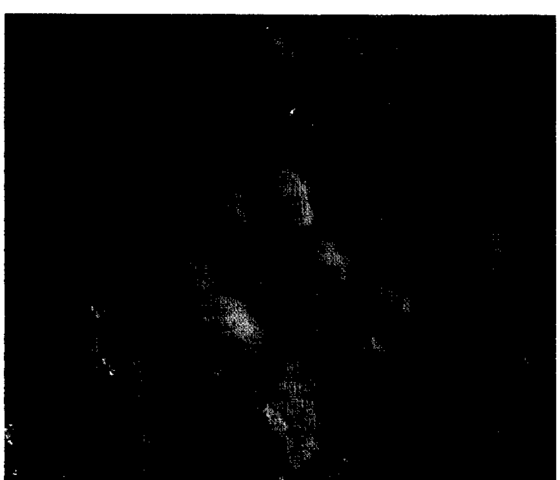
Many people are responsible for protecting the abundant natural resources within the Blackwater River watershed. The efforts of these community leaders, businesses, public and private landowners, government agencies and citizens are making a difference in assuring a healthy and productive watershed. Listed below are some outstanding examples of positive actions currently taking place to improve the river and its watershed.

Preventing Road and Storm-water Runoff

- Many roads and ditches are being grassed to prevent erosion in Conecuh National Forest.
- Santa Rosa and Okaloosa Counties and Blackwater River State Forest are paving miles of clay roads.
- Poorly designed and located culverts, bridges and roads in the Blackwater River State Forest are being replaced with low-water crossings and improved bridges.
- The Santa Rosa County Commission has created strong storm-water retention pond regulations.
- Bridges that span entire wetlands are being constructed in Okaloosa County.
- Area businesses have increased use of sediment retention ponds and spray fields that filter nutrients and sediment.
- Road management in the Conecuh National Forest and Blackwater River State Forest restricts vehicle access in sensitive areas and improves road access where appropriate to recreational spots near creeks and rivers.

Soil and Nutrient Control

- Several local farmers are participating in the Conservation Reserve Program and other Natural Resources Conservation Service programs that will help reduce soil and nutrient runoff from their farms.
- The Natural Resources Conservation Service, U.S. Army Corp of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Florida Department of Environmental Protection (DEP), Florida Department of Agriculture and Consumer Services, Florida Department of Transportation, and the Florida Three Rivers Resource Conservation and Development Council are helping restore large gullies.
- The city of Milton has provided sewer service to Whiting Field to remove a treated wastewater source into Clear Creek, a tributary of the Blackwater River.



Shifting sand on the bottom of the Blackwater River.

Stream animals, such as this immat…
depend on c…

Protecting Streamside…

- The city of Milton has construct… boardwalks and fishing piers.
- A boardwalk was added to a can… launch site in the Blackwater Ri… State Forest.
- Homebuilders and homeowners … protecting large trees and mainta… generous, vegetated streamside b…
- Landowners; concerned citizens; the Santa Rosa Clean Communi… System; and city, county and stat… agencies are planting native trees … shrubs along creeks, rivers, wetla… and retention ponds.

Implementing Best Management Practice…

- The Florida Forestry Associatio… assistance from the Florida Divi… Forestry, developed and led a log… BMP certification program that in… loggers about aquatic systems and … to better protect creeks and rivers.
- Timber companies and farmers are voluntarily using BMPs.

Cleaning up Litter

- Area canoe liveries are teaming up with the Santa Rosa Clean Community System to organize annual river clean-up programs.
- Community groups have "adopted" sections of the watershed which they regularly patrol and clean up.

Protecting the Watershed and Monitoring its Health

- Champion International and other timber companies are participating in the Sustainable Forestry Initiative to increase protection of water quality.
- The DEP and volunteer organizations, such as the Bream Fishermen's Association, are monitoring water quality in the watershed.
- The Gulf Coastal Plain Ecosystem Partnership — a voluntary landowner partnership in south Alabama and northwest Florida that includes The Nature Conservancy, Blackwater River State Forest, Champion International, National Forests in Florida and Alabama, Eglin Air Force Base and the Northwest Florida Water Management District — has established several cooperative watershed protection projects.

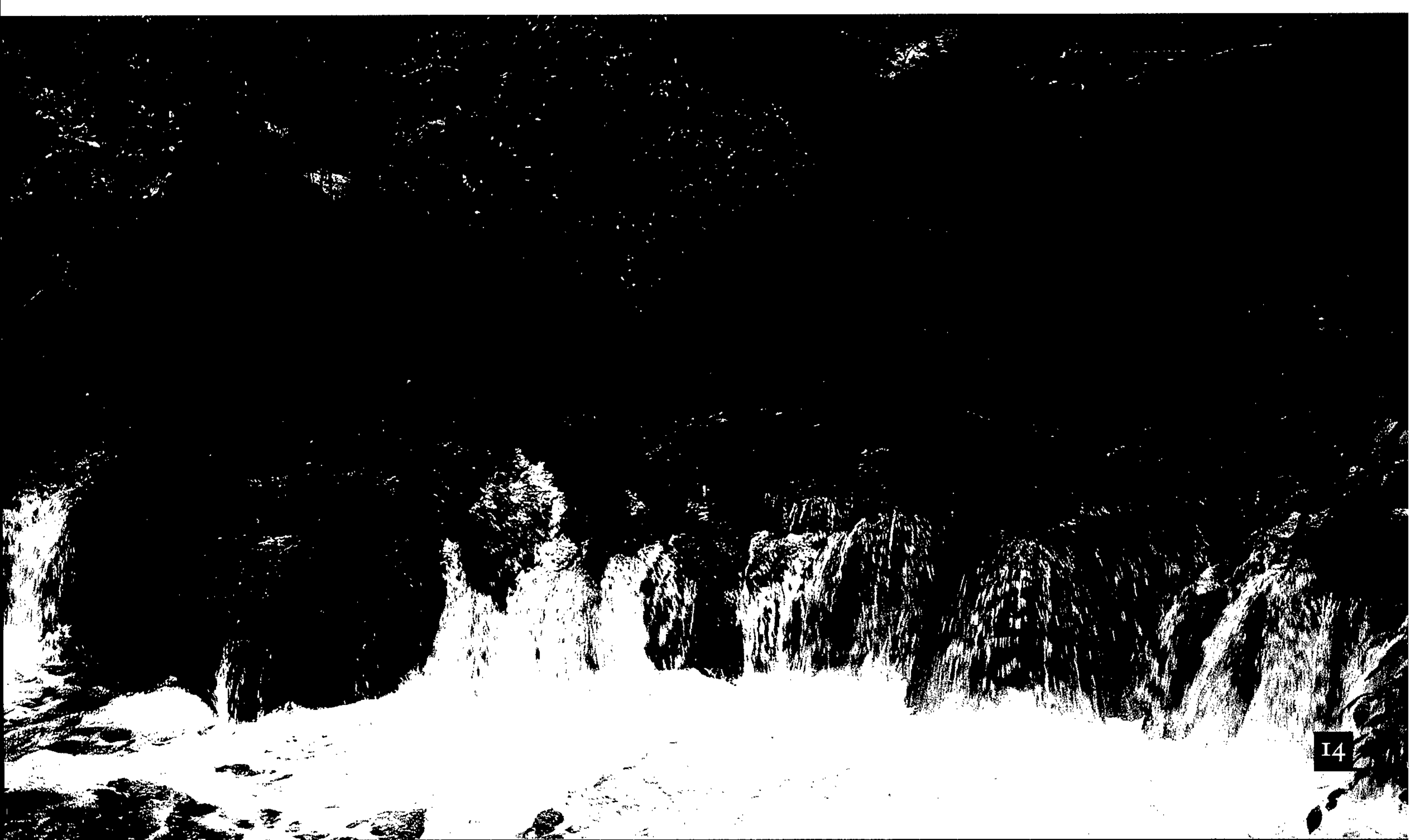
Water is the most critical resource issue of our lifetime and our children's lifetime. The health of our waters is the principal measure of how we live on the land.

Luna Leopold

We All Play a Role

There is a high cost to restoring environmentally damaged areas, repairing vandalized roads and cleaning up litter and illegal dump sites. On public lands, personnel and funds must be funneled from other needed projects to repair vandalized areas. If not, the public land agency is accused of not taking care of the land.

Most people love the Blackwater River and the lands surrounding it and use these areas responsibly. Responsible use of these valuable natural resources must be required not only by public land managers, but also by local politicians, community leaders, law enforcement and citizens. Use of the Blackwater River and public lands is a privilege that carries with it a great deal of responsibility.



Frequently Asked Questions

Q Why are public land managers closing areas, such as river sandbars and pitcher plant bogs, to vehicle access? Aren't they closing land that the public owns?

A Public lands remain open for public use. However, "public use" does not always mean "vehicle use." Some areas are restricted from vehicle access to protect sensitive natural resources. Driving in sensitive areas kills trees and understory vegetation which can cause erosion and sedimentation. Wetlands, streams and land with highly erodable soils are especially vulnerable to damage by motorized vehicles. These areas remain open for non-motorized use, which has less impact on sensitive areas.

Many county and city parks limit vehicle access by delineating vehicle parking areas. These areas are closed during certain hours because of safety and vandalism concerns. County and city officials show good leadership by managing these public areas for safety, access and protection of natural resources. To allow continual abuse or vandalism of these parks would be a tremendous waste of taxpayer dollars.

The same is true of state and national forests. Closing sensitive areas to vehicles actually preserves public access to them. If they continue to erode to the point of becoming a public safety hazard, all access would have to be restricted. Managers of public lands need the support of community leaders when they are faced with the tough decisions required to protect land and water and to manage public use.

Q Why are some roads on public lands being closed?

A Many of the area's roads were developed long ago without any regard to slope or soils. Off-road trails were developed to reach favorite recreation, fishing or hunting spots. Many of these roads were not used heavily and served local residents' needs of the time. As the Panhandle's forests and waters have become more popular over the last 20 years, use patterns have changed, and four-wheel drive vehicles have become more readily available to forest visitors.

Poorly located roads that receive high volumes of traffic quickly become eroded. Some road cuts, even with ongoing maintenance, are now 4 to 8 feet deep. (See photograph on page 6.) As alternatives to eroded roads, some forest users make new unapproved roads resulting in a network of abandoned, badly eroded roads that weave through the open longleaf pine woods.

Local public land agencies have begun intensive road management programs both to improve public access and to protect the area's natural resources. For example, Blackwater River State Forest has an estimated 1,500 miles of roads, including unauthorized roads. To date, few roads have been closed — mainly those that are located in sensitive areas, such as wetlands, bogs and creeks, and those that are causing excessive environmental damage. Most of these locations have designated parking areas that are within walking distance of creeks, rivers and sandbars.

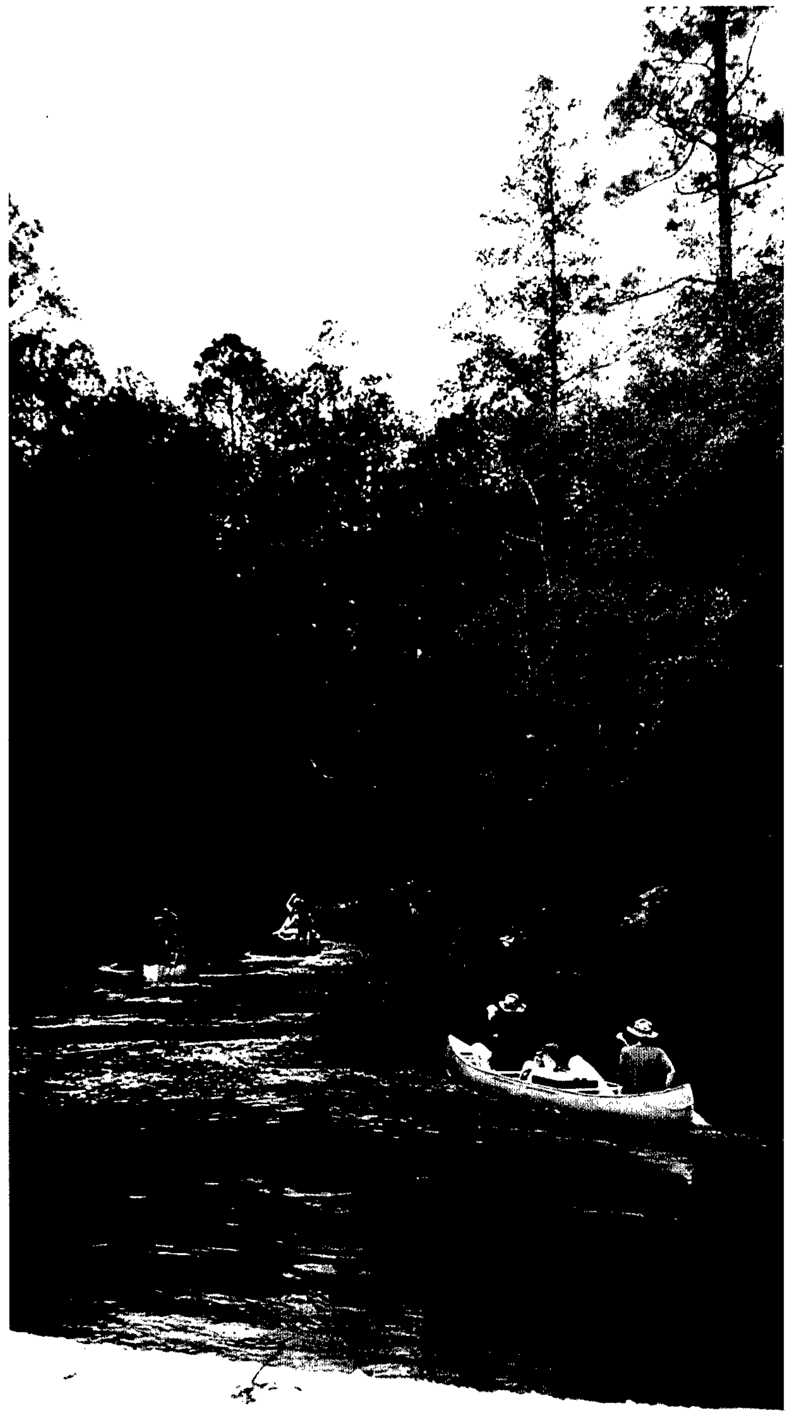
Did You Know ?

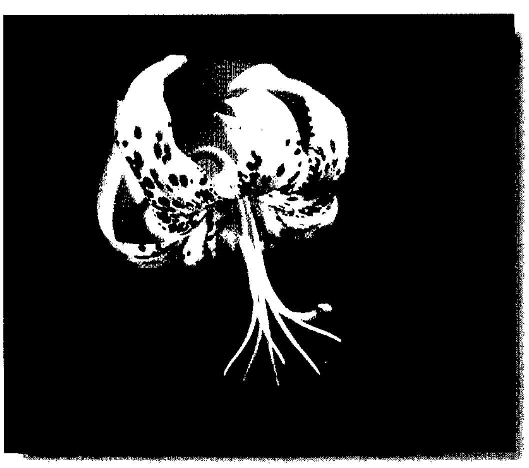
Adult mayfly.

A WATERSHED INCLUDES ALL LANDS THAT DRAIN INTO THE RIVER. ALL ACTIVITIES IN THE WATERSHED ULTIMATELY AFFECT THE RIVER.

NOT ALL SEDIMENT IS NATURAL. IN MANY AREAS, HUMAN ACTIVITY HAS ACCELERATED EROSION BEYOND HISTORICAL RATES. THE RESULTING SEDIMENT HAS SERIOUSLY HARMED THE CREEKS AND RIVERS WE ALL CARE ABOUT.

PEOPLE CAN LOVE A RIVER TO DEATH. TOO MUCH RECREATION CAN HARM RIVERS, ESPECIALLY IF THE RECREATION INVOLVES CUTTING AND REMOVING STREAMSIDE VEGETATION OR LITTERING.





Panhandle lily.

Acknowledgments

We greatly appreciate the cooperation and funding assistance provided by the Florida Department of Environmental Protection.

Thanks to the many individuals and groups who have contributed to the protection and responsible use of the Blackwater River watershed:

The Nature Conservancy
Gulf Coastal Plain Ecosystem Partnership
Pensacola Bay Ecosystem Management Advisory Council
Santa Rosa Clean Community System
American Forests
Francis M. Weston Audobon Society
Florida Wildlife Federation
Florida Forestry Association
West Florida Canoe Club
Florida Native Plant Society
Bream Fishermen's Association
American Forest and Paper Association
Volunteer Organizations

Written by Stephanie Davis, Vernon Compton, Perrin Penniman, and Cheryl Mall of The Nature Conservancy.

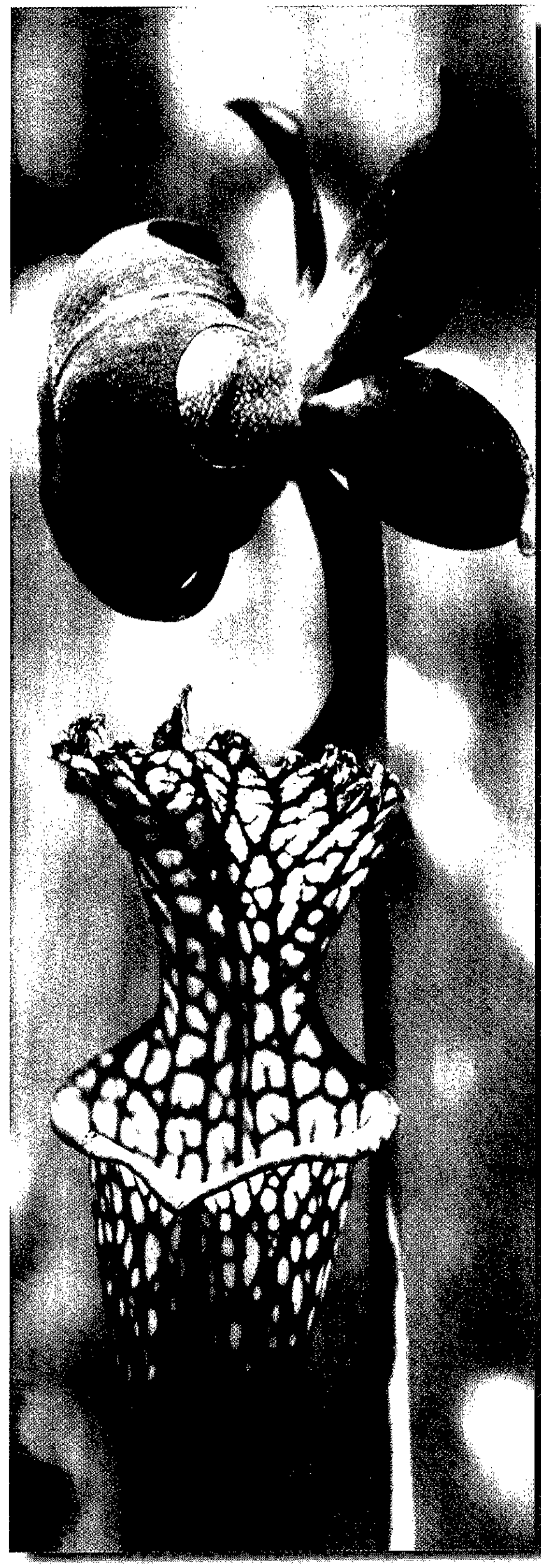
Design by Eric Blackmore Design.

Illustrations by Diane Pierce.

Photography by Tom Arrington, Vernon Compton, Stephanie Davis, Tom Fink, Donald Ray and the Santa Rosa Historical Society Inc.

Additional copies of this report can be obtained by contacting:

Gulf Coastal Plain Ecosystem Partnership
4025 Highway 178
Jay, FL 32565
Phone: (850) 675-5758



White-top pitcher plant.

If we work together in a cooperative spirit, looking into the future rather than the present day, we can offer this incredible natural world as a gift to those generations yet to come.

Barry Beasley

Longleaf pine-wiregrass dominated uplands in Blackwater River State Forest.

Volunteers plant grasses and trees to prevent erosion near a small stream.

Swamp along the Blackwater River.

The Nature Conservancy®

The mission of The Nature Conservancy is to preserve plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

Adaptive Management of Red-cockaded Woodpeckers in Northwest Florida: Progress and Perspectives

Summary Report
December 15, 1998

Prepared by:
Raymond A. Moranz and Jeffrey L. Hardesty
The Nature Conservancy

The Nature Conservancy®

APPENDIX B.

The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies, endorsements, either expressed or implied of the AAC/EMSN, U.S. Air Force, or the U.S. Government.

Effort sponsored by the AAC/EMSN, U.S. Air Force Materiel Command, USAF, under cooperative agreement FO8635-94-2-0001, amendment D
and the U.S. Department of the Army, under cooperative agreement DAMD17-98-2-8006.
The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon.

Report prepared for:

Eglin Natural Resources Branch
AAC/EMSN
501 DeLeon Street, Suite 101
Eglin Air Force Base, FL 32542-5133

Report prepared by:

Raymond A. Moranz and Jeffrey L. Hardesty

The Nature Conservancy
Public Lands Program
PO Box 118526
Dept. of Botany, University of Florida
Gainesville, FL 32611
(352) 392-7006

December 15, 1998
©The Nature Conservancy

Cover art by

Susan Johnston Carlson/TNC Clip Art File

R. A. Moranz and J. L. Hardesty. 1998. Adaptive Management of Red-cockaded Woodpeckers in Northwest Florida: Progress and Perspectives. Summary report of the July 21–23, 1998 workshop, Eglin Air Force Base. The Nature Conservancy, Gainesville, Florida.

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

WORKSHOP OVERVIEW

Background

From July 21 to July 23, 1998, the Natural Resources Branch of Eglin Air Force Base, in cooperation with the Gulf Coastal Plain Ecosystem Partnership, hosted an intensive workshop concerning Red-cockaded Woodpecker (RCW) (*Picoides borealis*) conservation on Eglin AFB and surrounding lands. The workshop was organized and moderated by staff from The Nature Conservancy. Participants included Eglin Natural Resources staff, managers from Blackwater River State Forest (BRSF) and Conecuh National Forest (CNF), and 37 other biologists, foresters, wildlife managers and conservationists from a variety of agencies, universities and NGOs. Contact information is presented in Appendix 1.

Red-cockaded woodpeckers have seen dramatic declines across their range. The RCW was federally listed by the federal government under the Endangered Species Act in 1970 and again in 1973. Red-cockaded woodpecker natural history, biology and status, including population declines and causes, have been well documented elsewhere (e.g., Jackson, 1971; Lennartz et al., 1987; Conner and Rudolph, 1991; and Walters, 1991). In brief, red-cockaded woodpeckers have evolved a cooperative breeding behavior particular to the dynamics of fire maintained southern pine forests. The RCW excavates cavities in living pine trees, a behavior that presumably provides RCWs with a competitive advantage over other cavity-requiring animals in an otherwise cavity poor environment. Existing suitable cavities have been demonstrated to be the critical limiting resource. Juvenile males typically attempt to inherit their natal territory and associated cavities by becoming helpers rather than seeking a breeding vacancy in an existing territory or excavating cavities in unoccupied habitat. Groups typically include a breeding male, female and one or more male helpers with one or more cavities each. Breeding groups require large territories and typically have home ranges >150 acres. Historically, RCWs occurred in large interconnected populations at relatively high densities. Red-cockaded woodpeckers can persist for decades in small, dense populations or as part of larger, less dense populations. However, once critical density and population size thresholds are exceeded, decline to local extinction can be rapid even if abundant suitable habitat exists. Today, only a few relict populations remain; most are small and isolated and many continue to decline.

A few large populations are still extant, including Eglin AFB. In the region covered by this workshop, relict populations also occur at BRSF and CNF; isolated groups also may occur on nearby public lands. The status of Eglin's RCW population has been the subject of intensive study for the past eight years. The status and distribution of RCWs occurring on CNF is well documented, while the BRSF has been less studied. Prior to the workshop, these populations and perhaps some isolated groups were assumed to be genetically and/or demographically connected, but the extent of connectivity was not known, nor was the extent to which co-management was necessary or possible.

The Gulf Coastal Plain Ecosystem Partnership, in part, was established to provide mutual assistance in recovering RCWs in this region. The Gulf Coastal Plain Ecosystem Partnership (GCPEP) consists of seven public and private partners who own or manage more than 840,000

interconnected acres in northwest Florida and southern Alabama (Figure 1). The GCPEP is a voluntary, cooperative effort. Under the auspices of GCPEP, natural resource managers from BRSF and CNF, together with Eglin managers, committed to explore the degree of interdependence among RCW populations and possibilities for co-management. These three public agencies co-sponsored an effort to monitor and model the population dynamics of RCWs in the Eglin/BRSF/CNF landscape. This workshop was the first occasion for the managers of these sites to interact with the modelers and learn of model results from the model's developers: Jeff Walters of Virginia Tech, and Larry Crowder and Jeff Priddy of the Duke University Marine Lab. The workshop provided managers with the opportunity to suggest alternative management scenarios that could be tested in future model runs.

Workshop objectives

The workshop had the following objectives:

1. Explain how RCW management fits within the larger Eglin adaptive management framework used to integrate management, science and decision-making;
2. review current RCW trend and distribution data from Eglin, BRSF and CNF;
3. review and interpret output from a spatially-explicit RCW modeling effort applied to the Eglin AFB (Eglin)-Blackwater River State Forest (BRSF)-Conecuh National Forest (CNF) landscape;
4. based on the model output, suggest RCW management strategies specific to Eglin, BRSF and CNF;
5. review outcomes of Eglin's RCW monitoring program, RCW adaptive management experiment, and RCW foraging study, focusing on biological and management implications;
6. review and discuss relationships among understory cover/composition and insect productivity;
7. discuss prescribed fire, hardwood and sand pine control and plantation conversion and relationship to RCW recovery;
8. discuss the role of longleaf pine harvest in maintaining or managing RCW habitat.

Adaptive management: integrating management and science

All managers make decisions in a context of considerable uncertainty and with a lack of adequate knowledge. Managing toward a sustainable or self-supporting population of RCWs requires a long-term commitment to managing large areas of suitable habitat. While red-cockaded woodpeckers are among the most studied and intensively managed species in the world, managers still must work in a climate of considerable uncertainty. The uncertainties of managing RCWs are of five primary types: 1) What are the critical ecological and biological processes that influence RCW distribution and abundance over time? 2) Given that natural disturbances will occur, what level of human-induced disturbance is acceptable? 3) What is a biologically sustainable number of RCWs given current or expected habitat conditions, rates of natural disturbance and expected human uses of RCW habitat? 4) How will these factors interact and change over time? 5) What is the timeframe of management?

Management decisions like these should be the result of meaningful public discourse, manager experience tempered by uncertainty, policy informed by ecological concepts and information gleaned from targeted scientific inquiry and ecological modeling. This approach has been called "adaptive natural resource assessment and management" (Holling 1978, Walters 1986). Adaptive management offers the premise that most resource policy and management decisions have uncertain and often unpredictable outcomes. Management becomes adaptive by turning routine management and monitoring into large-scale experiments and through the use of modeling exercises that allow managers, scientists, citizens and decision-makers to make explicit their assumptions and examine complex interactions over large areas and long timeframes. This approach enables managers to better predict and understand the effects of their decisions and allows learning from mistakes. However, it also necessitates up-front integration of planning, decision-making, science and management. Adaptive management often requires working across administrative boundaries at multiple scales. Partnerships are defined by the scale of the problem, not by which neighbors or players are easiest to work with.

In traditional management, learning is obstructed in several ways: 1) managers assume they know the outcome of management actions, so monitoring is often viewed as unnecessary; 2) when monitoring does occur, management activities may be poorly replicated in space and time and thus monitoring results may be not be broadly applicable; 3) monitoring or research are most often initiated following a crisis, thus discerning cause and effect may not be possible, 4) traditional applied research often does not mimic the scale of management, thus results may not be applicable at larger scales of actual management, and 5) models are seldom used, thus managers may fail to grasp long-term change and the interaction of multiple factors. Eglin managers have attempted to counter these problems by placing management actions, where possible, in a larger adaptive management framework (Figure 2).

For an adaptive approach to effectively inform management, important questions need to be identified, assumptions articulated, predictions made, key biological factors monitored and processes developed to incorporate and interpret information as feedback to policy. Management questions arise from the goals and objectives of existing legal mandates and management plans and from the concerns of decision-makers, managers, scientists, regulators and the public.

At Eglin, the concept of ecological integrity has guided goal and objective setting (DoD-Air Force 1993). Under these goals, natural resource managers and scientists pose questions, form management-related hypotheses, construct models, predict outcomes and, where possible, conduct controlled and replicated experiments in a management context. Eglin managers and scientific collaborators use inventory, monitoring, research, modeling and dialogues as tools to temper experience and provide input to policies and practices (Figure 2). At Eglin, adaptive management of red-cockaded woodpeckers includes monitoring and habitat management placed in an experimental framework, habitat modeling and RCW population modeling.

CURRENT STATUS OF RED-COCKADED WOODPECKERS OCCURRING ON LANDS MANAGED BY GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP ORGANIZATIONS

Eglin AFB

Table 1 outlines the recent history of red-cockaded woodpecker management at Eglin AFB (for a review of the historical causes of decline, see Hardesty 1992, Hardesty et al. 1997). Two especially important milestones were the initiation of surveying for RCW clusters in 1990 (completed in 1996) and breeding season monitoring in 1992, enabling managers to obtain estimates of RCW abundance and trends from 1994 to the present (C. Petrick, pers. comm.). Numerous demographic parameters also were monitored at a representative sample of active clusters to obtain estimates of demographic parameters, including breeder turnover and reproductive rates (Hardesty et al., 1997). A sample of inactive clusters also was monitored in order to estimate the rate at which abandoned clusters were reoccupied.

From 1992-1996, abundance of natural clusters on Eglin's eastern side decreased by an estimated 26%, while increasing on Eglin's western side by 6.6%. During the same period, group size increased. From 1996-1998, the eastern subpopulation gained one natural cluster, while the western subpopulation gained 19 for a 10% increase. The number of active artificial clusters increased from 15 in 1996, to 25 in 1997 and to 42 in 1998. Overall, Eglin RCW populations have increased steadily, with the number of active clusters growing from an estimated 217 in 1994 to 280 in 1998 (Table 2) (B. Hagedorn, pers. comm.).

Blackwater River State Forest (BRSF)

The size of the historical Blackwater River State Forest RCW population probably was between 300 and 600 active clusters (based on a density of 1 cluster per 250 to 500 acres). Steep population declines probably occurred as a result of the sudden loss of cavity trees and foraging habitat due to overharvest in the 1920s prior to ownership by the state of Florida. However, historical photos indicate that many relict longleaf pines were left as culls or in unlogged areas along streams (DOF 1998). The resulting RCW population density was most likely much reduced and highly fragmented, setting in motion the process of demographic isolation (see modeling results below). As the forest began to recover under state ownership, the common practice of selectively removing culls and poorly formed trees (many of which were undoubtedly RCW cavity trees) no doubt continued to exacerbate the problem. By the time of federal listing in the early 1970's, BRSF was estimated to have had approximately 50 active clusters (DOF 1998).

Division of Forestry (DOF) biologists first surveyed known clusters in order to estimate RCW abundance in 1990 (Florida Division of Forestry 1998). They recorded increasing numbers of RCW clusters during the early 1990's (Table 2), but attributed this increase to their improved ability to locate and assess the status of clusters. Each year since 1995, DOF biologists have detected fewer RCW clusters at BRSF. They attribute this observed decline to multiple factors:

1. the loss of suitable habitat and subsequent abandonment of active clusters due to development of dense hardwood midstories around cavity trees resulting from a lack of appropriate fire;

2. cluster abandonment and lack of formation of new clusters or recolonization of abandoned clusters, due to demographic isolation (see discussion of modeling results below);
3. more recently, the destruction of six active cavity trees by Hurricane Opal, and;
4. sampling error resulting from the switch in 1998 to more discriminating and accurate methods for evaluating cluster activity (i.e., monitoring not just for the presence of adults but for the presence of an active nest).

From 1993-95, BRSF staff also surveyed 43,000 acres of forest that were not known to have RCWs, but did have longleaf pines that were 60 years old or older. They found no new active clusters during this survey. The remaining acreage at BRSF lacks stands of old, well-spaced trees, and is unlikely to host RCWs.

BRSF staff began nest monitoring and banding in the spring of 1998. Blackwater's 15 active pairs produced 11 successful nests with 33 eggs, 25 nestlings and 19 fledglings during spring 1998.

Conecuh National Forest (CNF)

The historical causes of RCW population declines at Conecuh are assumed to have been similar to those at BRSF and Eglin AFB. The number of active RCW clusters at Conecuh National Forest declined from 30 in 1978 to 11 in 1993 (R. Lint, pers. comm.). Linear regression based on these data indicated that if this trend had been allowed to continue, active clusters would be extirpated from CNF by 1999 (R. Lint, pers. comm.).

To halt the decline, CNF began active management of RCW populations in 1993. From 1993-1998, managers translocated five pairs and three single birds into CNF. All of the translocated single birds successfully nested on site during the following breeding season, as did three of the pairs. To ensure that adequate nesting sites were available, managers added more than 150 cavity inserts to the active clusters, and additional inserts in areas that lack active clusters, but that are likely to be highly suitable RCW habitat in the near future. Lastly, managers increased the amount of growing season burning from 850 acres in 1993 to over 12,000 acres in 1995 and each of the subsequent years.

The management efforts quickly brought favorable results. The long-term population decline was halted, and the number of active clusters increased to 14 (Table 2). This number likely would be higher if not for the loss of significant numbers of cavity trees during Hurricane Opal in 1995.

PREDICTING RCW POPULATION DYNAMICS: USE OF AN INDIVIDUAL-BASED, SPATIALLY EXPLICIT RCW MODEL

Overview of model purpose and methods

Development of individual-based species models requires access to long-term data that are available only from intensive studies occurring over many years. Red-cockaded woodpeckers are among the most intensively studied animals in the world, and thus ample data are available

from a variety of sources, including Eglin AFB. Scientists Larry Crowder and Jeffrey Priddy of the Duke University Marine Laboratory and Jeffrey Walters of Virginia Tech University constructed and intensively tested a model that was used to simulate RCW population dynamics in the North Carolina Sandhills (Letcher et al., 1998). For this workshop, they adapted the already existing model using data from the Eglin/Blackwater River State Forest/Conecuh National Forest RCW subpopulations. The model is individual-based, in that it predicts the future abundance of RCWs by tracking the fate of individual birds and their progeny. The model also is spatially-explicit, placing each bird within a territory whose coordinates can be located on an actual landscape (e.g., western Florida/southern Alabama landscape) (Figure 3).

An important early insight that emerged from testing of the model was that population density, more so than just population size, was the major determinant of individual cluster and population persistence and stability (J. Walters, pers. comm.). Thus, smaller, more densely packed populations may persist much longer than larger populations where each cluster is on average more isolated. This insight has important repercussions for managers. These model results mirrored observations from a number of populations and explained why some small, relict populations appear to be more stable than some much larger populations and why isolated groups and groups on the edge of populations are more vulnerable to abandonment. The model incorporates an important peculiarity of RCW cooperative breeding biology—the trait of helpers to move primarily into vacancies on their own territories or those nearby. An important by-product of this behavior is that if abandoned, territories are unlikely to be reoccupied after being vacant for more than three years; isolated territories or those on the edge of any population center are even more likely to become and remain vacant.

The purpose of the model is to simulate complex population dynamics in a way that will allow managers and scientists to assess potential trends in population size and distribution by monitoring the movements of individuals among subpopulations while tracking the fate of individual breeding territories over time and space. The model allows managers to examine their RCW populations with and without active management and thus, allows managers to better assess the economic and biological uncertainty associated with the choice of specific management interdictions. Perhaps the most valuable contribution of the model is its ability to estimate the probability of cluster and subpopulation loss due to current demographic isolation.

Populations were modeled for 20 and 100 years. The initial model runs assumed only that managers would continue to use appropriate habitat management techniques in existing habitat; initial runs assumed that artificial cavity construction and translocations *were not* used, except that existing artificial clusters were included if present in year one to set initial conditions. Initial starting conditions used the best available estimates of the number and location of active clusters on each site as of the 1996 breeding season, including, where known, solitary male clusters. Estimates of group size, productivity, breeder turnover rate and a variety of other parameters were estimated using data from Eglin AFB, or when not available, from studies conducted in North Carolina. Fluctuations in life history traits due to environmental fluctuation were not *explicitly* included as a separate model function. However, environmental variation is *implicitly* captured in some variables (e.g., variation in productivity) because, to the extent possible, parameter estimates derived these populations were used in the model. For example, the

demographic effects of several hurricanes, tropical storms, droughts and tornadoes are captured in the six years of monitoring data derived from Eglin AFB. Possible outcomes, including the probability of cluster extinction, were based on 15 model runs for each scenario.

For the sake of simplicity, initial model runs assumed that suitable habitat and potential cavity trees were readily available and that hurricanes and other catastrophic events would not have a major impact on RCWs and their habitat. Clearly, these initial assumptions were overly simplistic, but initial model runs were intended to be used by managers to understand how populations might behave independent of habitat quality or large weather events and without intensive RCW-specific management. Thus, to some extent, the model may overestimate RCW persistence; actual predicted declines may be greater or more rapid and predicted increases may be smaller or slower.

Modeling and implications for RCW management at Eglin, BRSF and CNF: A caveat

The following discussion of modeling results has potential implications for policy and management decision-making at Eglin, BRSF and CNF. The Gulf Coastal Plain Ecosystem Partnership is a voluntary and cooperative effort. The recommendations of participants and the insights gained from this modeling effort in no way obligates managers to take any specific action and does not represent the official policy of any member. True to the GCPEP agreement, partners are committed to sharing resources and responsibilities where feasible and productive, including the best available scientific evidence and expertise. The following comments, information and expert opinion are in keeping with that spirit.

Model results and their biological implications for Eglin managers

The model suggested that very little dispersal probably occurs between Eglin and the other two sites (Table 3), thus, predictions for Eglin are discussed separately from those associated with BRSF and CNF. The model predicted that RCW abundance at Eglin will slowly decrease over the next 40 years, due to increasing isolation of individual clusters and a resulting population collapse in Eglin's eastern subpopulation. However, it also predicted that the western subpopulation would slowly increase in number throughout the 100 years of the simulation, so that the number of RCWs at Eglin would be greater in 100 years than it is now (Figure 4) (but see comment below on reliability of 100 year predictions).

Participants agreed that the model is a boon to managers; model predictions allow for better allocation of scarce resources by indicating which subpopulations and clusters have a higher probability of persistence over the long-term. This utility is perhaps best illustrated by an example from Eglin.

Eglin's current RCW management plan calls for stabilizing the eastern subpopulation by linking it with the western subpopulation. The plan assumed that stabilization would occur as a result of building a demographic "bridge" between the two subpopulations by improving habitat conditions and increasing the number of clusters and density of clusters in the central corridor lying between the two subpopulations. The bridge clusters, and hence the eastern subpopulation, would be sustained by immigration from the western subpopulation and by continuing to improve habitat in the bridge area. While intuitively obvious and mirroring the recommendations

of a number of experts over the years (documented in Hardesty 1992), model runs conducted during the workshop suggested that this may not be an effective strategy, either biologically or economically. Rather, the model suggested that the eastern subpopulation would grow more quickly if artificial clusters and translocated birds were used to buffer the core and edges of the eastern subpopulation—essentially managing the eastern subpopulation in isolation from the western. The bridge clusters were generally not predicted to persist over time. Moreover, if borne out by future model runs, this will mean shifting the priority of habitat restoration, including intensive control of hardwood and sand pine, from the bridge area to several large areas that were thought to be of lower priority. Further model runs, however, are required to validate this strategy.

Workshop participants validated the model and generally agreed with its predictions. Participants observed that patterns of abandonment of single clusters and groups of clusters predicted by the model were in fact already in process (i.e., model runs using 1996 and 1997 data as starting conditions could be compared with 1998 monitoring data). Participants and modelers alike noted, however, that the model appeared to be most reliable when simulating population dynamics over shorter time frames of 20 or 30 years or when populations are predicted to decrease. Because the model is not yet tied to an underlying habitat model, simulated population increases over longer timeframes may be predicted to occur in areas of permanently unsuitable habitat (e.g., water), painting a rosier picture of future increases and population density than may be possible. However, of the six subpopulations simulated (two on Eglin, three on Blackwater and one on Conecuh), only the western subpopulation on Eglin was predicted to increase in the absence of active management.

Model results and their biological implications for Blackwater River State Forest and Conecuh National Forest

The model suggested that very little dispersal probably occurs between Eglin and the other two subpopulations, but that the persistence of the CNF and BRSF subpopulations are highly dependent on immigration of RCWs between them; of the two, BRSF is more dependent on CNF than is CNF on BRSF (Table 3). When these two subpopulations were modeled independently for 20 years, the model depicted the rapid decline of RCW numbers at both BRSF and CNF (Figure 5). When modeled together for 100 years, simulations predicted their disappearance at these sites within 35 years (in the absence of intensive RCW management efforts). Participants accepted the validity of these predictions. Both BRSF and CNF have some small, isolated groups of active clusters that appear to be especially vulnerable to extirpation. The pattern of abandonment predicted by the model based on data from 1996 has already begun to occur (Florida DOF 1998).

Both BRSF and CNF have groupings of RCW clusters near their common boundary. The model predicted that these clusters are linked demographically through movement of individual birds among these territories. Moreover, the model suggested that this grouping constitutes a subpopulation. Blackwater River State Forest groups farther south (the "Floridale" clusters) appear to be isolated both from Eglin and CNF, as well as from most other clusters on BRSF. This group of clusters is estimated to disappear in fewer than 10 years without intensive management. If the goal of RCW management on BRSF and CNF is to increase RCW numbers

to a point of relative stability, then the model output strongly suggested that the most cost and biologically effective approach would be to stabilize the northern BRSF-CNF subpopulation by increasing as rapidly as possible the number of groups by means of artificial cluster construction and translocation. In the meantime, BRSF and CNF managers could stabilize groups of more isolated clusters through appropriate cavity and habitat management. However, additional model runs need to be conducted to examine the efficacy of these strategies. Evidence from Eglin suggests that managers at BRSF and CNF may be able to "beat" the model: intensive management at Eglin has resulted in RCW increases that exceed model predictions for unmanaged scenarios by up to 30%.

Linking Eglin to BRSF and CNF: The role of the Champion Connector parcel

Participants debated the relative importance of the Champion Connector parcel in current and future efforts to stabilize RCW populations in the GCPEP area. Clearly, based on the historical habitat, the three subpopulations were part of a larger regional RCW population. The Yellow and Blackwater rivers probably were not significant barriers to landscape-level RCW dispersal. Except for the very bottom of major river drainages, swamps and some isolated areas naturally protected from fire, the landscape was dominated by longleaf pine (Schwartz 1994). Available evidence suggests that RCWs would have occurred in all longleaf pine-dominated sandhills, scrubby flatwoods, and in the longleaf and slash pine dominated mesic flatwoods. Thus, RCWs would have occurred on the Champion connector parcel, which consists primarily of xeric sandhills that have been converted to sand pine plantations, along with various other plant communities associated with the Yellow River Ravines and bottoms. As a member of GCPEP, Champion managers are interested in understanding how these lands might contribute to the conservation of RCWs or other species, both now and in the future.

Modeling results suggested that Eglin is isolated from the BRSF-CNF subpopulations; the isolation is a result of the unsuitable habitat found along the Yellow River, but more importantly, extensive habitat conversion north the river and south of BRSF, including the Interstate corridor and Champion lands. At present, because of the distance between the Eglin and BRSF RCW population centers, and because bolstering existing population centers appears to be a more important short-term strategy, it does not appear that the Champion parcel is essential to short-term RCW recovery. However, participants held divergent opinions about how the Champion parcel may factor into long-term RCW management efforts. Table 4 captures the gist of these comments. The consensus view is that bolstering the connection between BRSF and CNF RCW groups is a relatively more important strategy over both the short and long-term.

Translocation of RCWs from Eglin to BRSF and/or CNF: biological and management considerations

Based on model results, workshop participants proposed the translocation of birds from Eglin to the other two sites. While populations at BRSF and CNF would benefit directly, some suggested that Eglin would benefit indirectly; stable populations at the other sites would help to ensure the future of RCWs in the western Florida/southern Alabama landscape. For instance, the presence of stable populations at BRSF and CNF would greatly reduce the chance that a single or multiple hurricanes would extirpate RCWs from the entire landscape.

Workshop attendees posed the following questions concerning translocation:

1. Does Eglin have enough "spare" birds to withstand losses due to translocation without slowing recovery on Eglin?
2. Would Eglin managers be willing to achieve reduced population growth in order to provide birds to the more imperiled BRSF and CNF subpopulations?
3. Who would pay for translocation costs, including the cost of monitoring?

From the perspective of Eglin managers, causing their RCW population to grow at the highest possible rate best supports their mission to achieve recovery as rapidly as possible; the reason being that rapid recovery to a set (and as yet undetermined) population size/density will increase their future management options by allowing a more flexible relationship with USFWS regulators. Therefore, it behooves the Eglin managers to retain their birds on-site in the short-term. The biologically best and most cost-effective distribution of RCWs on Eglin will be examined in future modeling scenarios. In the short-term, Eglin managers plan to continue translocating RCWs from Eglin's western subpopulation to its smaller, eastern subpopulation. At a meeting in Tallahassee, Florida, this past August, Eglin managers informed the U.S. Fish and Wildlife Service that they would not translocate Eglin birds to other managed areas before at least 2001 (C. Petrick, pers. comm).

Suggested Additional Model Scenarios

The initial modeling scenarios provided GCPEP managers and scientists with necessary baseline conditions, namely, what would be the likely fate of RCWs in the absence of intensive management (see above). Managers and scientists alike realized that, while the model would point them in the direction of effective management strategies, additional model runs would be required to assess the effectiveness of any proposed strategies. The following additional modeling efforts were deemed to be the obvious next steps. These suggested scenarios require refinement, but captured the suggestions of participants.

I. Eglin-BRSF-CNF

A. Model all former historical habitat as if saturated with active clusters (CNF-287, BRSF-175, Eglin 500+, Champion connector parcel-25).

- When modeled over 20 and 100 years, what is the fate of the connector parcel clusters? Does this group of clusters remain relatively stable in number? How often do individuals move across the connector parcel *vs.* movement across other potential corridors? Does the connector parcel appear to play an important role under this best case scenario?

B. Add five artificial clusters with translocations to both southwest Conecuh and NW BRSF, which represents a reasonable short-term management strategy given current budgets and the availability of RCWs.

- What is the demographic effect?

C. Add 30-60 active clusters to BRSF and 50 to CNF as a way of estimating whether this total population number constitutes an increasing or stable population size.

II. CNF:

A. Model demographic outcome of 287 active clusters, the density required in the current recovery plan.
   - Does this constitute a quasi-stable population size when modeled over 20 and 100 years?

III. BRSF:

A. Model demographic outcomes for 175 groups over 20 and 100 year periods, the minimum projected historical population on BRSF.
   - Does this constitute a quasi-stable population size?

B. Model the 77 documented active and inactive clusters as active over 20 and 100 year periods.
   - Does the population decline or increase? Where?

C. In the three existing population centers, add ten empty artificial clusters to each population center.
   - What is the outcome? Is this an effective strategy?

D. In the three existing population centers, add ten artificial clusters augmented with RCW groups of variable sizes.
   - What is the outcome? How much more effective is this strategy than 3.c?

E. Run scenarios 3.c) and 3.d) with the CNF population.
   - What are the outcomes?

IV. Eglin:

A. Using the current distribution of clusters, add 15 artificial clusters to each subpopulation in year one. All new clusters are to be constructed near existing clusters in locations that optimize the probability of being occupied.
   - How does this strategy affect future population dynamics, particularly in the eastern subpopulation? Is this a more effective strategy than attempting to build a population "bridge" between the two subpopulations?

B. Using the current distribution of clusters, increase the model budding rate to 10%.
   - Use the locations of newly budded clusters to estimate the best locations for future artificially constructed clusters.

LESSONS LEARNED FROM EGLIN'S ADAPTIVE RCW MANAGEMENT EXPERIMENT

Background

Virginia Tech researchers Jeff Walters, Carola Haas and Kathy Gault initiated a five-year adaptive management experiment at Eglin in 1995 (Walters et al. 1997). Their primary objective is to compare the population response of RCWs to different combinations of management practices. Experimental treatments are:

1. ecosystem management[1] (maintaining the longleaf pine ecosystem through prescribed burning and appropriate silvicultural management)

---

[1] Ecosystem management as used here is euphemism for management driven by ecosystem-level concerns, as

2. ecosystem management and cavity construction
3. ecosystem management, cavity construction and cavity management (maintenance of at least three good cavities per cluster)
4. ecosystem management, cavity construction, cavity management, hardwood removal and translocation (of females to unpaired males, males to unoccupied artificial clusters and pairs to unoccupied artificial clusters).

Treatments 1 and 2 were applied to plots that the researchers considered "non-critical" because they are located on the western half of Eglin and already have numerous RCW clusters. Treatments 3 and 4 were applied to "critical" plots in the eastern half of Eglin that hosted small numbers of RCW clusters.

As of July 1998, the researchers had not yet statistically analyzed data from the first three breeding seasons: they are currently analyzing these data, and will publish their findings at the end of 1998. At Eglin's RCW Management Workshop, Jeff Walters summarized data up to the 1997/1998 non-breeding season. Preliminary data are provided below.

Artificial cavity construction

Between autumn 1993 and early spring 1998, the RCW Research Team added a new territory for each territory that was occupied within a plot, for a total of 77. In the second breeding season following the construction of cavities, occupation rates were 40% in the non-critical, western experimental plots but only 20% in the critical, eastern plots. The likely explanation is that the non-critical area already had a higher population density, thus it had a greater availability of birds to occupy the sites.

Translocation of birds to Eglin's eastern subpopulation

Translocation of birds from the western to the eastern subpopulation resulted in the formation of new clusters in Eglin's eastern subpopulation (Walters et al. 1997). During the 1995/96 non-breeding season, six birds (two pairs, two single males) were moved to four clusters. During the 1996/97 non-breeding season, five single birds were translocated to five artificial cavities. None of the 11 birds stayed in the cluster where they had been placed, but seven remained in the vicinity through the 1997 breeding season. Finally, during the 1997/98 non-breeding season, five birds were moved to five clusters. They are currently collecting data on these five birds.

The donor population has been stable from 1995-97, even as birds were removed. Group size remained above acceptable levels, as did the number of fledglings/group. Unfortunately, translocation appears to have suppressed growth in the donor population. One potential method of lessening impact on the donor population would be to expand the size of the donor area, so that the impact is spread over a relatively broader area. Regardless of potential impact, most workshop attendees placed high value on the maintenance of an RCW population in the eastern half of Eglin, and voiced their support for further translocation within Eglin.

---

opposed to just the needs of a single species. In actuality, ecosystem management seeks to resolve the social, institutional as well as the ecological challenges underlying the management of complex, regional ecosystems.

Comparison of treatments

Treatments 1 and 2 were beneficial to RCW populations in the non-critical plots at Eglin. The investigators considered a mean group size of 2.5 or greater to be one indicator of a healthy population, and in 1997, average group size on these plots was 2.68 individuals/group. While ecosystem management alone added 0.5 clusters/plot/year, addition of artificial cavities along with ecosystem management added 1 cluster/plot/year. Populations grew at a rate of 3% in the plots that received Treatment 1, and 5% in plots that received Treatment 2.

The critical plots on Eglin's eastern half had a group size of 2.64 individuals, comparable to that of the western plots. More new active clusters (1.3/plot/year) formed in plots that received Treatment 4 (the most intense treatment and the only one that included translocation) than in plots that received Treatment 3 (0.8 new active clusters/plot/year).

RCW MONITORING AT EGLIN

Currently, there are three annual RCW surveying/monitoring programs at Eglin:

1. Each year, Eglin staff survey all active clusters in order to update the status of each cavity tree. They also survey 50 inactive clusters each year.
2. Within the donor population, Virginia Tech's RCW Research Team intensively monitors all potential donor clusters to determine availability of females for translocation. Monitoring includes banding of all RCWs, and estimating group and intergroup size, clutch, hatchling and fledgling production, and breeder turnover rates.
3. The RCW Research Team intensively monitors a randomly-chosen sample of active clusters to obtain the same estimates as 2. above. These data are used to make inferences about the Eglin RCW population as a whole.

At the workshop, Carl Petrick asked if the inferences made from the data obtained by the third program were worth the high cost. Petrick asked Ralph Costa, RCW Recovery Coordinator for the U.S. Fish and Wildlife Service, which data are necessary from the point of view of the regulators. Costa replied that the essential data are 1) the number of active clusters and 2) the trend in the number of active clusters over the years. These data can be obtained without banding birds, performing fledgling checks and other time-consuming tasks of intensive monitoring. Two possible modifications that would lower the costs of data collection at Eglin are:

1. Estimating the number of breeding groups by checking for nests in all active clusters, as they do at Fort Stewart, GA, instead of having intensively monitored and banded subset;
2. Abandoning fledgling checks on Eglin, because they are not needed to identify potential juvenile females for translocation.

Some attendees suggested that Eglin maintain the intensive monitoring program even after the completion of the adaptive management study, pointing out that banding is important for understanding dispersal within and among populations. Additionally, Costa informed the workshop that continued gathering of demographic data through intensive monitoring of a subset

of the population will make consultation with his agency easier, with a faster and probably more favorable outcome for Eglin. Conclusion: Carl Petrick stated that he would maintain the intensive monitoring program through the duration of the adaptive management experiment to 2001, but will be considering a reduced monitoring program thereafter.

RCW FORAGING PREFERENCE, HABITAT USE & HOME RANGE SIZE AT EGLIN AFB

Background

This study provided a credible scientific basis for management of RCW habitat on Eglin. The study is summarized in detail in Hardesty et al. 1997. Studies elsewhere have shown that RCW population numbers are limited by at least four environmental factors: 1) loss and fragmentation of habitat due to conversion, 2) degradation of habitat due to hardwood midstory encroachment, 3) shortage of suitable cavity trees and 4) demographic isolation. Other environmental factors may constrain RCW population growth, including limited foraging area or lack of suitable or preferred foraging resources within available habitat. The existing US Fish and Wildlife Service guidelines for estimating appropriate levels of foraging resources and area appeared to be inappropriate for Eglin RCWs, primarily because the guidelines were developed from studies of RCW populations occurring in forests with more productive soils and a different habitat structure.

The 187,515 ha Eglin installation is comprised of 78% longleaf pine-turkey oak (*Pinus palustris-Quercus laevis*) associations occurring on highly xeric, deep sands. In 1997, Eglin was estimated to have a population of 243 active RCW clusters or approximately 221 groups consisting of one to six birds. The objectives of this study were to 1) estimate home range size of RCW groups consisting of at least a breeding pair, 2) estimate the foraging resources used and available, 3) determine habitat preference or avoidance based on habitat structure, 4) relate home range size to RCW demographic and habitat variables, 5) relate RCW demography to habitat structure and composition, 6) document gender-based foraging preferences and 7) recommend biological and management thresholds for key habitat variables.

Researchers from the University of Florida and The Nature Conservancy studied a sample of 25 Eglin RCW social units (groups) consisting of at least a breeding pair with or without attendant helpers in 1993–94 and 18 RCW groups in 1994–95. Each group defended a territory consisting of a cluster of cavity trees occurring in longleaf pine-hardwood forests of varying habitat structure and composition. Home range sizes were estimated by following each group two to four times per month during one of three four-hour periods during the day. Home range sizes were estimated using minimum convex polygons. RCW demographic variables, including density, group size, clutch size, brood size and number of young fledged were measured. Eighteen habitat variables also were measured, ranging from pine density to understory cover based on randomly chosen points in the vicinity of foraging observations. For analysis, per group home range and demographic variables were averaged across two years (one year for seven groups).

Results and recommendations

Several new findings were reported:

1. At Eglin AFB, RCWs prefer both larger *and* older (>150 years) trees as a foraging substrate significantly more often than expected;
2. on average, successful RCW groups used home ranges that were 46% larger than unsuccessful groups; and
3. in simple regressions, significant variation in RCW productivity was explained by increased forb cover (35% of variation), decreased hardwood height (28%), decreased hardwood dbh (26%) and lower densities of pines ≥25 cm dbh (22%). In multiple regressions, only forb cover explained significant variation.

For successful groups, home ranges averaged 126 ha versus 86 ha for unsuccessful groups. Successful groups used home ranges that contained more pines, but not more large pines, than did unsuccessful groups, despite having larger home ranges. Regression models indicated that the extent of forb cover was more important (i.e., explained a greater proportion of variability in reproduction) than the structure of the hardwood midstory or pine overstory. In all cases, regression models showed consistent relationships among increased RCW productivity, an open pine overstory, suppressed hardwood midstory and a well-developed herbaceous (i.e., forb) ground cover. These results provided the basis for Eglin-specific management recommendations. The recommendations included methods for estimating home range boundaries and habitat quantity and quality in occupied RCW habitat, and a means for estimating the suitability and quality of unoccupied RCW habitat. We present these detailed recommendations in Appendix III.

This study contributed to and supported more recent studies that have begun to link RCW population health to ecosystem processes. These results support the hypotheses put forth by F. James and colleagues working on the Apalachicola National Forest in Florida. They suggested that ecosystem processes, particularly frequent fire, may be as important as habitat structure and resource quantity in determining population health. In particular, they hypothesize that RCW nutrition is related to increased quality and quantity of arboreal insects resulting from increased nutrient mobility mediated by frequent fire. Researchers conducting studies in Blackwater River State Forest (FL) and Escambia Experimental Forest (AL) found that insect biomass on longleaf pines was correlated with increasing ground cover. This observation, and that of others, that male and female RCWs segregate foraging activity, with females foraging primarily on tree boles, suggests a possible link between ground cover quality and female nutrition. However, further study is required to elucidate these relationships. Regardless, these results emphasize the importance of frequent prescribed fire and protecting and restoring native ground cover.

Habitat management recommendations from this study were consistent with overall ecosystem recovery and restoration objectives. Eglin managers were cautioned against managing stands solely on the basis of RCW habitat needs; Eglin forests were no doubt always associated with significant habitat heterogeneity at the landscape level. While RCW productivity is important, other demographic factors are perhaps even more critical to population health, including population density and connectedness. The management recommendations put forth by the researchers were conservative. These recommendations have two purposes, to provide a

reasonable level of security for RCWs, while providing managers with a reasonable level of decision-making certainty. Underlying these recommendations is the assumption that it is better to err on the side of caution. These recommendations will in some cases provide more habitat than is necessary for sustaining occupation and reproduction by some RCW groups. As the Eglin population increases in size, so will the area of the total Eglin landscape set aside for their recovery. This will undoubtedly lead to increased conflicts among different users of Eglin's resources. Periodic review and update of these management recommendations is essential. Within reason, managers should be permitted to carry out most management actions within RCW foraging areas that are intended to benefit the integrity of the longleaf pine-turkey oak ecosystem as a whole. If applied in an adaptive management context with adequate monitoring and evaluation, these recommendations should aid in recovery of RCWs, as well as longleaf pine ecosystems, on Eglin.

RELATIONSHIPS AMONG UNDERSTORY COVER/COMPOSITION AND INSECT PRODUCTIVITY

Despite large-scale manipulation of the vegetation for management and restoration of the once dominant longleaf pine systems of the southeastern US, published work on arthropods is rare compared to studies of vegetation response. This paucity of research is surprising given the dependence of economically important breeding game birds and the federally endangered red-cockaded woodpecker on herb-layer arthropods in longleaf pine forests.

In a large-scale experiment, researchers from The Nature Conservancy, Tall Timbers Research Station and the University of Florida examined relationships among densities of nine arthropod orders and several measures of tree abundance and plant groundcover: basal areas and hardwood species basal areas; longleaf pine density (trees >25 cm DBH); canopy cover; graminoid cover; wiregrass and pineywoods dropseed cover; forb cover; woody species cover; bare ground cover; fine litter cover; woody litter cover; longleaf pine juveniles (<1.4 m high and not from the 1996 seed crop); longleaf pine seedlings from the 1996 seed crop; and plant species richness. To avoid multi-colinearity among independent variables, a subset of variables was chosen that were not significantly intercorrelated. Each arthropod order density was regressed against all variables in the subset using multiple regression.

During the pre-treatment period of this study, researchers found no significant dependence of arthropod densities on a subset of eight uncorrelated independent variables measuring groundcover plant composition and tree species basal area. One year after treatment application (growing season burn, herbicide, chainsaw felling of hardwoods, and no-treatment control), homopterans (Homoptera) and thrips (Thysanoptera) densities were the only arthropod orders that were significantly explained by a multiple regression model composed of six uncorrelated independent variables. Homoptera density was positively explained by graminoid cover and negatively by the density of longleaf pine juveniles. Graminoid cover was significantly and positively correlated to woody groundcover species cover, plant species richness, and the basal area of longleaf pine. There was a negative correlation between longleaf pine juveniles and bare ground cover and a positive one to woody species cover. Overall, these results support the idea that fire shaped the variation in homopteran density. The basal areas of turkey oak and sand live oak, respectively, negatively and positively explained thrips density.

Because the basal area of sand live oak was highest in burn plots, the researchers again suggest that fire influenced thrips densities. They concluded that land managers seeking to enhance arthropod diversity and abundance will benefit from the positive effects of growing season burning on some arthropod taxa.

RCW HABITAT MANAGEMENT AT EGLIN

Prescribed fire

At a similar workshop at Eglin in 1992, external scientists and managers stated that the single most important tool for RCW habitat management and ecosystem recovery was prescribed fire (Hardesty 1992). In that workshop, participants recommended greatly increasing the frequency and acreage of fire, particularly growing season fire. Both scientists and managers alike acknowledged that broad-scale application of fire, especially growing season fire, may have some unexpected results. However, prescribed fire was seen as so important that application should not wait for any further scientific study. Monitoring was seen as important, but not necessarily essential in the short-term. Following the recommendation of the workshop, Eglin managers worked to overcome a series of constraints, doubling the rate of prescribed fire, including growing season fire.

These efforts produced generally good results for RCWs, but also surprising and sometimes negative results. RCWs have apparently responded favorably to increased fire. Evidence comes from the preliminary outcomes of the RCW adaptive management experiment, anecdotal observations, the recorded increases in the number of active clusters, and increasing trends in other important parameters, including the proportion of territories occupied by breeding pairs, group size and productivity.

Recently however, prescribed fire planning and application have been in a state of flux at Eglin. Since, 1996, Eglin fire managers have not met their objectives. Application of prescribed fire has been hampered by a number of factors, with many constraints apparently self-imposed (Table 5). Probably the single most important cause was conflicts among natural resource management objectives, resulting primarily from a breakdown in the internal decision-making process, especially in priority setting and planning. Secondly, Eglin managers were not as aggressive in seeking military support for prescribed fire assistance as they had been in the past. Some of these problems also may be related to the complexity of moving from a compartmentalized management approach (e.g., forestry, wildlife departments) to an integrated adaptive management approach; ecosystem management at Eglin, despite much progress, is still a work in progress.

To their credit, Eglin managers have resolved many of these problems. Long-term prescribed fire now has planning priority, with all other objectives being tied to the timing and location of proposed fires within burn units. Recent innovative modeling efforts sponsored by Eglin are helping managers to better define an ecologically acceptable and operationally feasible management regime (Peterson et al. 1998). Early modeling results echo the recommendations of participants, that Eglin will have to decrease the return interval (to <5 years) and increase the acres burned (up to at least 80,000 acres per year) in order to maintain existing RCW habitat and

achieve restoration of unoccupied habitat. Excellent progress also has been made in reducing other key constraints, including procuring the use of a helicopter for aerial ignition.

The recommendations at this workshop echoed those of earlier workshops: fire and RCWs are inextricably linked, and the more fire the better. From the perspectives of RCWs, participants generally agreed that any fire was better than no fire, and that growing season fire was still the tool of choice, all else being equal (but see old-growth mortality issues below). Managers also stated that in some cases, restoration using fire alone was either too slow or was an ineffective means of reducing the dominance of hardwoods and sand pine once critical structural thresholds had been reached (see mechanical hardwood and sand pine removal below).

Participants had the following prescribed fire-related suggestions:

1. Increase fire frequency in burn plans (burn each unit every 5 years, or more frequently, if possible)
2. Take advantage of wildfires and escapes by incorporating ranges in burn blocks and developing reasonable fire breaks[2]
3. Develop larger burn units
4. Increase the use of aerial ignition
5. Create less restrictive management objectives for each burn
6. Accept higher variability in any given burn
7. Accept higher mortality of younger pines; conservative burning to "save" pines is often times more harmful (e.g., longer fire residence time) than aggressive burning
8. Increase staff assigned to prescribed fire (the use of volunteers was suggested)
9. Consider following initial growing season burns by dormant season burns to better protect cavity trees and old-growth individuals
10. Within burn units, plan other management activities around prescribed fire plans
11. Prescribed fire may not always be the first management technique of choice; fire in combination with mechanical methods may be necessary and desirable where fine fuels are extremely limited and where the restoration schedule needs to be advanced (e.g., in critical RCW habitat).

Fire-related loss of old-growth longleaf pine

Eglin AFB is home to the largest remaining stands of old-growth (>125 years) longleaf pine. Many relict old-growth individuals also are interspersed in younger stands. In general, RCWs require or prefer older trees (>125 years) for cavity excavation on Eglin. In addition, RCWs foraged on older trees and especially larger trees at rates significantly greater than their availability. In general, suitable potential cavity trees are not a limiting factor on Eglin, except in some areas. Cooperating scientists and Eglin managers have observed that an unusual number of old growth pines have died soon after prescribed fires. Rather than infernos that scorched the entire tree, these fires were typically controlled burns in which the flames stayed in the understory, and therefore, it is unclear how they contributed to mortality. Eglin managers

[2] In many cases, Eglin managers have been doing this for five or more years.

expressed their need to learn more about this issue. Workshop attendees suggested two factors that may play a role in increasing mortality:

1. In the absence of frequent fire, a thick duff layer can develop under pines, which is a preferred substrate for fine roots that are especially vulnerable to fire;
2. Lack of sufficient soil moisture under pines, which may lead to overheating of feeder roots;
3. Significant accumulation of dead hardwood stems from previous fires may be contributing to LLP mortality during subsequent prescribed burns.

All three of these problems, if valid, are perhaps solvable. Fire managers can measure soil moisture and postpone burns when too low. Thick duff layers can be reduced by prescribing multiple, cool fires. Attendees also suggested that Eglin's managers take advantage of learning opportunities when burning old growth. For instance, placing temperature-sensitive paint palettes in different microenvironments within a stand may enable managers to better understand the heat distribution during burns. Examining causes of mortality at every opportunity using an interdisciplinary team also was recommended. However, managers also noted that postponing burns or prescribing multiple dormant season fuel reduction burns adds to the list of constraints and makes fire planning more difficult. Eglin managers and cooperating scientists also will examine this issue at an upcoming adaptive management workshop focused on longleaf pine ecosystem restoration issues. Concerning the potential threat posed by the accumulation of burned hardwoods, Carl Petrick, chief of Eglin's wildlife branch, recommends that sandhills choked with hardwoods should first be burned aggressively, but then burned once in the dormant season in order to reduce fuel. He recommends that subsequent burns be performed in the growing season.

Sand pine and turkey oak removal

Participants were unanimous in supporting Eglin's plan to convert by mechanical means a significant proportion of Eglin's 60,000 acres of sand pine-invaded plant communities back to longleaf pine domination. These same stands also have a significant oak component, especially turkey oak, a naturally occurring species found in virtually all longleaf sites on Eglin. The Choctawhatchee variety of sand pine also is a naturally occurring component of Eglin's forest ecosystem, but was formerly restricted only to areas with very infrequent fire (e.g., ravine systems and coastal areas). Prescribed fire is most effective when sand pines are less than approximately 4 inches DBH.

Important caveats to this recommendation were that sand pine removal should be a priority in critical RCW habitat areas first, and then in other areas as feasible. Secondly, participants noted that removal has to be coordinated with fire planning at the landscape scale; sand pine removal areas can become quickly invaded when sand pine seed is present, either in the seed bank or from nearby stands. Many worried, also, that mechanical removal of sand pine would damage the existing understory vegetation community, which in turn could compromise this most important of system attributes, and one that is tied to fire, RCW productivity (see previous discussion) and restoration of biological diversity. However, from the perspective of RCWs, few choices are available. Without fire, understory plant communities gradually lose the competition with oaks

and sand pines. Steve Seiber, Chief of Eglin's Forestry branch, pointed out the need for research on this topic. Eglin is committed to using techniques that are least damaging to groundcover species. As with fire and old-growth mortality, Eglin managers and cooperating scientists will examine this issue at an upcoming adaptive management workshop focused on longleaf pine ecosystem restoration issues.

LITERATURE CITED

Conner, R. N. and D. C. Rudolph. 1991. Forest habitat loss, fragmentation, and Red-cockaded Woodpecker populations. Wilson Bull. 103: 44-457.

Florida Division of Forestry. 1998. Blackwater River State Forest red-cockaded woodpeckers: history, current status and management plan (draft of 12/9/98). Florida Division of Forestry, Tallahassee, FL.

Hardesty, J. L. 1992. The red-cockaded woodpecker and ecosystem management on Eglin Air Force Base, Florida; Directions and Priorities. Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville.

Hardesty, J. L., K. E. Gault and H. F. Percival. 1997a. Ecological correlates of red-cockaded woodpecker (*Picoides borealis*) foraging preference, habitat use and home range size in northwest Florida (Eglin Air Force Base), final report, Research Work Order 99. Florida Cooperative Fish and Wildlife Research Unit, Dept. of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL.

Hardesty, J. L., K. E. Gault and H. F. Percival. 1997b. Trends, status and aspects of demography of the red-cockaded woodpecker (*Picoides borealis*) in the sandhills of Florida's Panhandle, Part II, final report, Research Work Order 146. Florida Cooperative Fish and Wildlife Research Unit, Dept. of Wildlife Ecology and Conservation, University of Florida, Gainesville, FL

Hooper, R. G., L. J. Niles, R. F. Harlow, and G. W. Wood. 1982. Home ranges of red-cockaded woodpeckers in coastal South Carolina. Auk 99:675–682.

Jackson, J. A. 1971. The evolution, taxonomy, distribution, past populations and current status of the Red-cockaded Woodpecker. Pages 4-29 in The ecology and management of the Red-cockaded Woodpecker (R. L. Thompson, ed.). Bur. Sport Fish. Wildl, U.S. Dept. Int., and Tall Timbers Res. Stat., Tallahassee, Florida.

Lennartz, M. R., R. G. Hooper, and R. F. Harlow. 1987. Sociality and cooperative breeding of Red-cockaded Woodpeckers, *Picoides borealis*. Behav. Ecol. Sociobiol. 20:77-88.

Letcher, B. H., J. A. Priddy, J. R. Walters and L. B. Crowder. 1998. An individual-based, spatially-explicit simulation model of the population dynamics of the endangered red-cockaded woodpecker. Biol. Conserv. 86: 1-14.

Priddy, J. A. 1998a. Dispersal patterns, [online]two pages of graphics. Available URL: http://spot.ml.duke.edu/rcw/eglin/dispersal.html [October 16, 1998].

Priddy, J. A. 1998b. Adjustment of "Too Close" territories, [online] two pages of graphics. Available URL: http://spot.ml.duke.edu/rcw/eglin/adjust.html [October 16, 1998].

Priddy, J. A.. 1998c. Territorial survival, [online] three pages of graphics. Available URL: http://spot.ml.duke.edu/rcw/eglin/occupied.html [October 16, 1998].

Provencher, L., D. R. Gordon, K. E. M. Galley, J. L. Hardesty, H. L. Rodgers, J. Sheehan., E. Levine, G. W. Tanner, L. A. Brennan, and K. W. Blandford. 1996. Pre-restoration analysis of plants, invertebrates, and birds in sandhill systems at Eglin Air Force Base, Florida. Annual report to Natural Resources Branch, Eglin Air Force Base. The Nature Conservancy, Niceville, FL.

Provencher, L., H. L. Rodgers, K. E. M. Galley, J. L. Hardesty, G. W. Tanner, D. L. Gordon, J. P. McAdoo, J. Sheehan, and L. A. Brennan. 1997. Initial post-treatment analysis of restoration effects on plants, invertebrates, and birds in sandhill systems at Eglin Air Force Base, Florida. Annual Report to Natural Resources Branch, Eglin Air Force Base. The Nature Conservancy, Niceville, FL.

Schwartz, M. W. 1994. Natural distribution and abundance of forest species and communities in northern Florida. Ecology 75: 687-705.

U. S. Fish and Wildlife Service. 1985. Red-cockaded Woodpecker Recovery Plan. US Fish And Wildlife Service, Atlanta, GA.

Walters, J. R. 1991. Application of ecological principles to the management of endangered species: the case of the Red-cockaded Woodpecker. Annu. Rev. Ecol. Syst. 22: 505-523.

Walters, J. R., C. A. Haas and K .E. Gault. 1997. Adaptive management of red-cockaded woodpeckers on Eglin Air Force Base, Florida: Experimental Study. Phase 1 Final Report. Virginia Polytechnic Institute and State University, Blacksburg, VA.

Table 1. Chronology of RCW related events occurring on Eglin AFB (compiled by Carl Petrick, Eglin AFB).

Early 1970's	First large scale planting of LLP
1973	First plotting of RCW trees on aerial photos
1975-1988	Periodic requests for T&E survey dollars (all denied)
1979	First RCW surveys to support military missions
1986	Section 7 Consultation for B-75 tank range (finding of insufficient information). Project scaled back.
Oct. 1988	USFWS Panama City FL office receives Section 7 Consultation responsibility
1988-1989	First test mission receives Jeopardy Opinion for RCW and Okaloosa darter
1989	First Growing Season Prescribed burn conducted
1989-1990	Jeopardy Opinion gets elevated to Center Commander (Over $600K becomes available for RCW Survey)
May 1990	University of Florida RCW Survey started
Feb. 1992	First RCW workshop held
Spring 1992	Initiation of RCW breeding season monitoring
March 1993	First Eglin INRMP signed (Beginning of Ecosystem management on Eglin)
1993	University of Florida RCW Foraging Study initiated
1993	First use of aerial ignition in prescribed burning program
1993	First use of artificial cavities on Eglin (Carter and Associates)
1995	Initiation of Va. Tech Adaptive Management RCW experiment
May 1996	Gulf Coastal Plain Ecosystem Partnership MOU signed
1996	First RCW translocations conducted on Eglin

Table 2. The number of active RCW clusters at Eglin Air Force Base, Blackwater River State Forest (BRSF) and Conecuh National Forest (CNF) from 1990-1998.

Year	Eglin	BRSF	CNF
1990	N/A.	27	N/A.
1991	N/A.	28	N/A.
1992	N/A.	28	N/A.
1993	N/A.	*	11
1994	217	32	14
1995	229	35	11
1996	244	31	13
1997	264	24	13
1998	280	18	14

*data collection at BRSF in 1993 was incomplete

Table 3. The number of dispersal events that occurred between managed areas during the 15 replicate simulations of the population model (Priddy 1998a).

	to Eglin	**to Blackwater**	**to Conecuh**
from Eglin	N/A	12	1
from Blackwater	13	N/A	25
from Conecuh	2	65	N/A

Table 4. Summary of comments from workshop participants concerning the potential importance to RCW conservation of the Champion International property that connects BRSF and Eglin AFB.

Important	Not Important
• Potentially important for long-term RCW population expansion from Eglin to Blackwater/Conecuh, or north/south dispersal in the event that any of these populations is decimated by a hurricane • If used as a dispersal corridor, would increase ability of Eglin RCW population to help offset inbreeding depression on Blackwater-Conecuh • Connection of Eglin and BRSF-CNF may re-establish pre-Columbian pattern of gene flow among the subpopulations, and would act to reduce genetic drift in both populations • Most important attribute may be that it provides a continuously forested corridor between Eglin and Blackwater, even if not longleaf pine, and thus may facilitate occasional movement of individuals	• Not important in short run since habitat is unsuitable, and few RCWs apparently require it for movement; better to focus $$ on Eglin and BRSF-CNF population centers • May not be important except for helping to offset genetic drift over hundreds of years if RCWs use the site as a dispersal corridor or population linkage • The gap between Eglin clusters and BRSF-CNF cluster may continue to increase because of cluster abandonment on the periphery of both populations, thus a corridor would be redundant • Significant time lag before connector parcel offers suitable nesting habitat (~ 70 yrs.) following restoration of longleaf pine

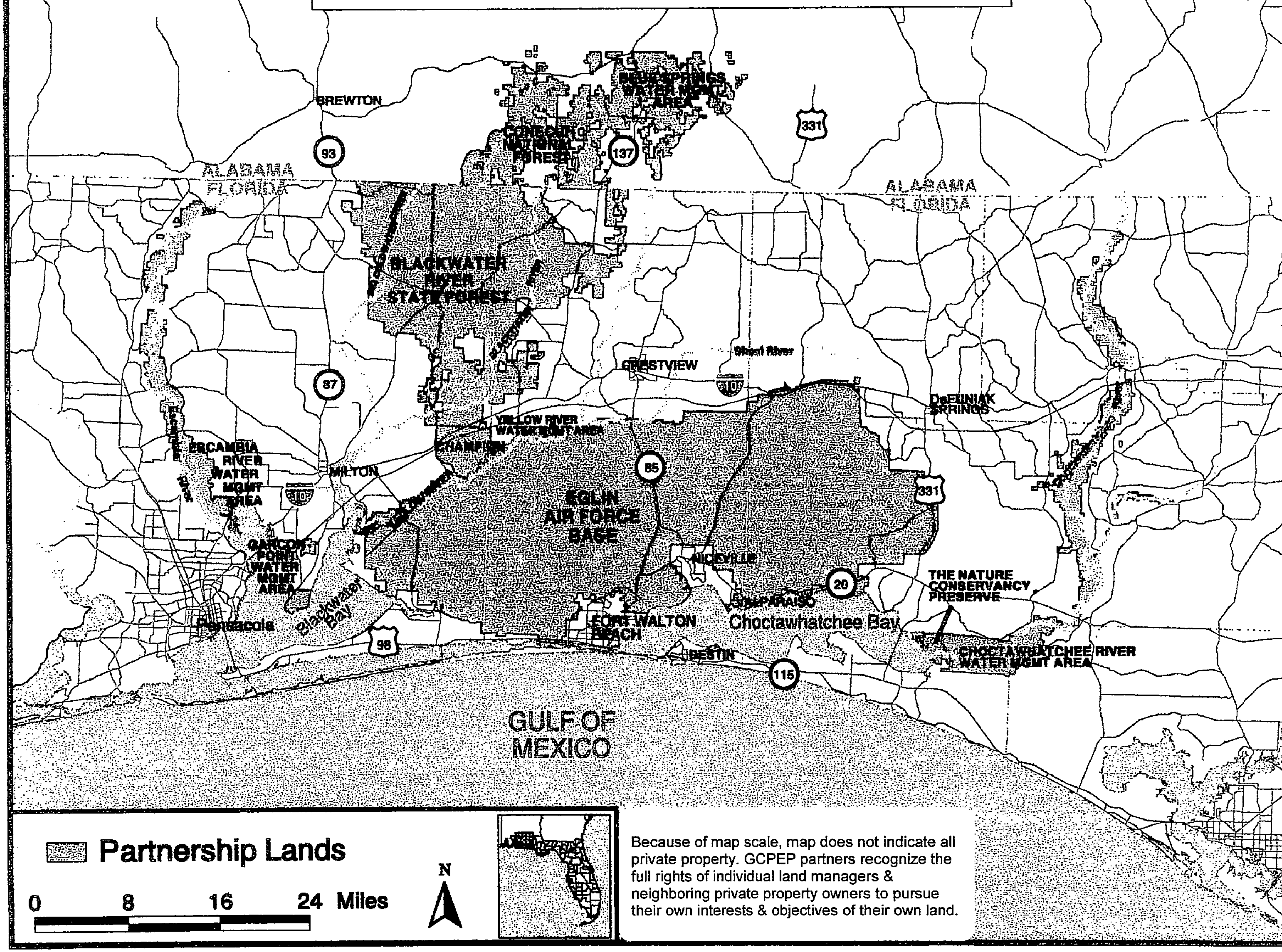
Table 5. Prescribed fire constraints at Eglin AFB and their sources, internal and external.[3]

Internal to Natural Resources Branch	External to Natural Resources Branch
• Each site is scheduled to burn on an infrequent basis (>5 years) and some sites are missed in some years • Personnel shortage • Exclusion of fire to protect: a) natural longleaf regeneration b) artificial longleaf regeneration c) research plots • Landscape fragmentation and juxtaposition of different kinds of management units • Too many different and sometimes conflicting management objectives (e.g., longleaf regeneration, quail management, RCW management, etc.) • Too much fine tuning of prescriptions and too much time spent planning • Lack of clear overall decision framework • Lack of helicopter for aerial ignition	• Test mission is visibility (smoke) sensitive • Military mission timing and frequency reduces fire windows • lack of $$$ • Urban-interface fuels have increased to dangerous levels • Personnel shortage • Other smoke constraints (e.g., highway visibility, adjacent urban areas) • Negative public attitudes; not a major problem, but constant

[3] Eglin managers resolved a number of these contraints immediately prior to or after the workshop.

Figure 1. Map of Gulf Coastal Plain Ecosystem Partnership

GULF COASTAL PLAIN ECOSYSTEM PARTNERSHIP



Because of map scale, map does not indicate all private property. GCPEP partners recognize the full rights of individual land managers & neighboring private property owners to pursue their own interests & objectives of their own land.

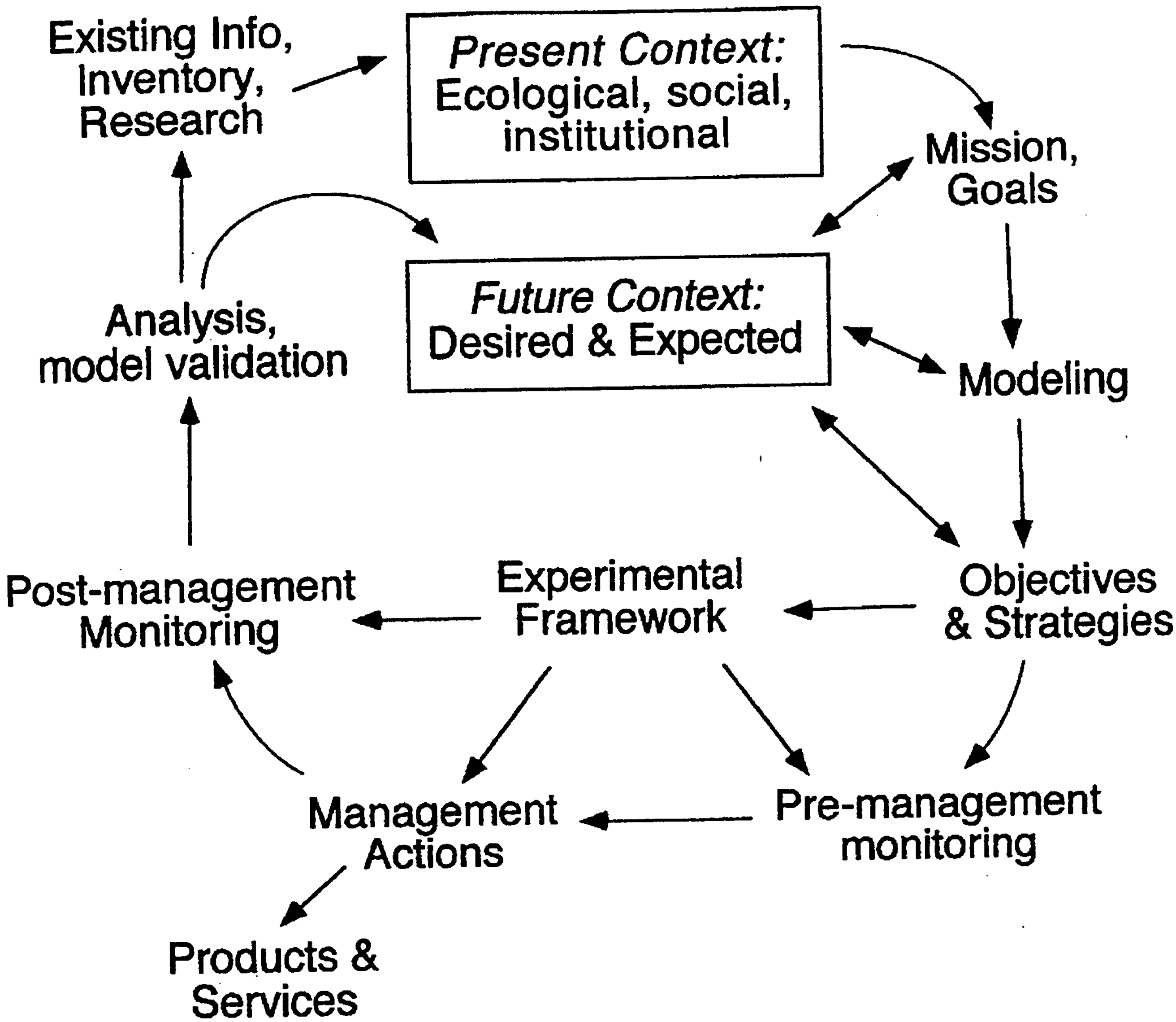


Figure 2. Adaptive management process at Eglin Air Force Base, FL. Management activities are associated with pre- and post-monitoring and, where possible, are conducted in a larger experimental context that promotes understanding of cause and effect. Modeling allows managers to link the present with the future and, similarly, to better integrate human desires (e.g., ecosystem products and services) with expected system behavior and productivity

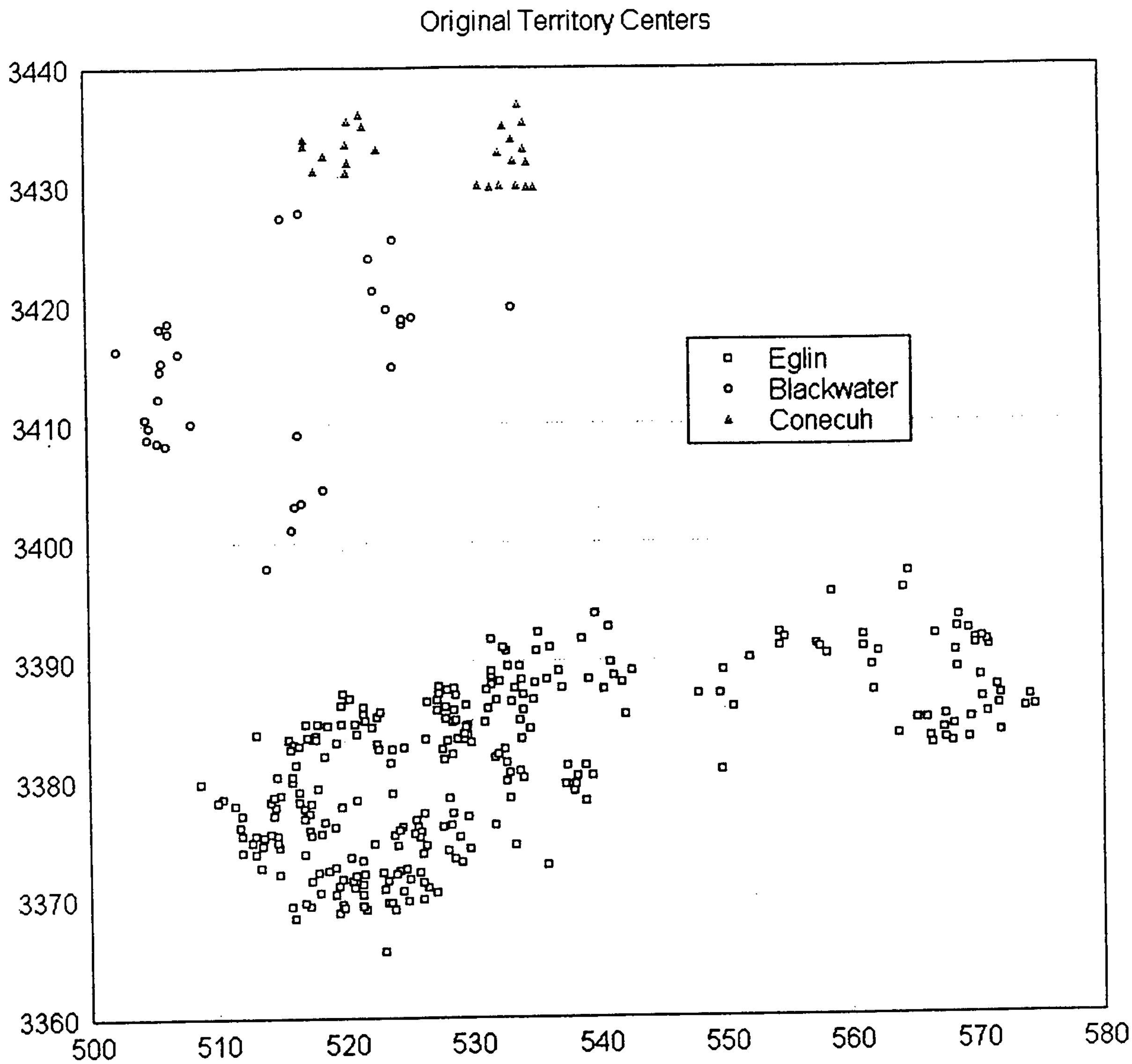


Figure 3. Locations of RCW clusters in BRSF, CNF and Eglin. Distance between nearest parallel gridlines represents 10 km. From Priddy 1998b.

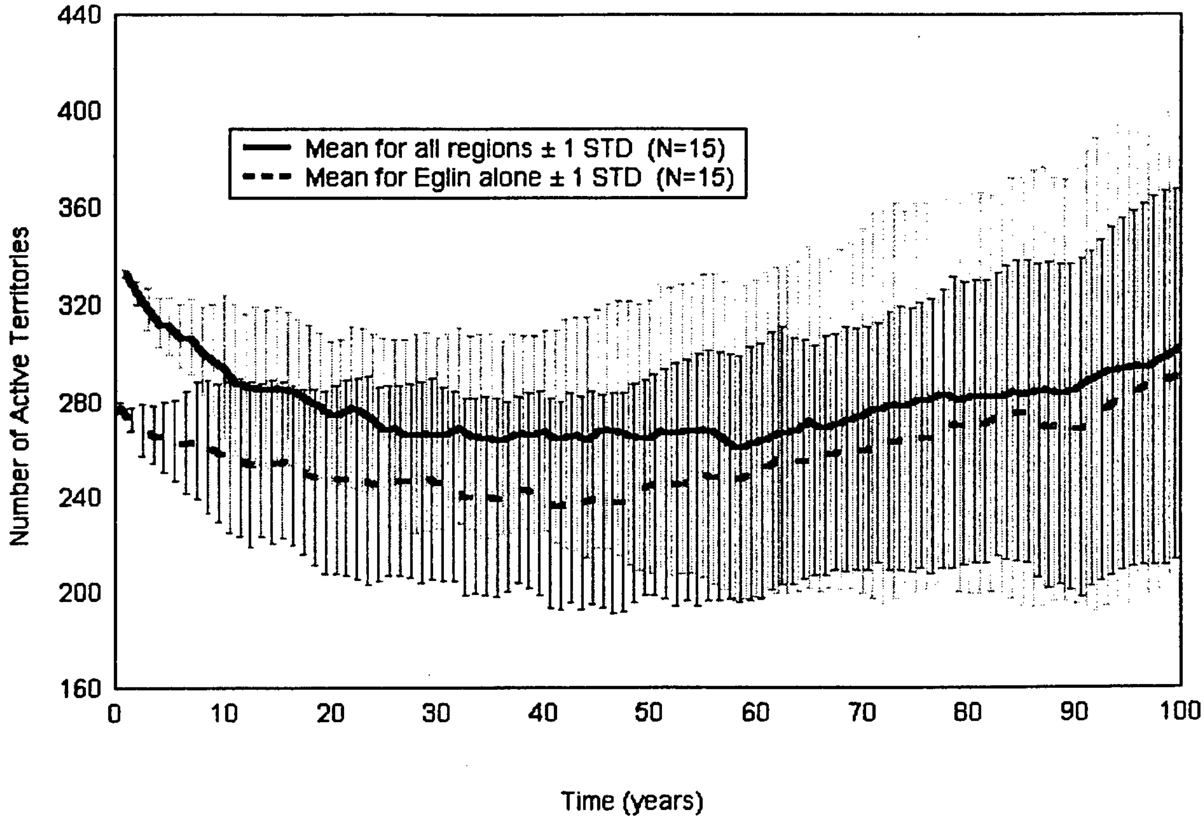


Figure 4. RCW population trends at Eglin AFB and the entire landscape as modeled over a 100-year period. From Priddy 1998c.

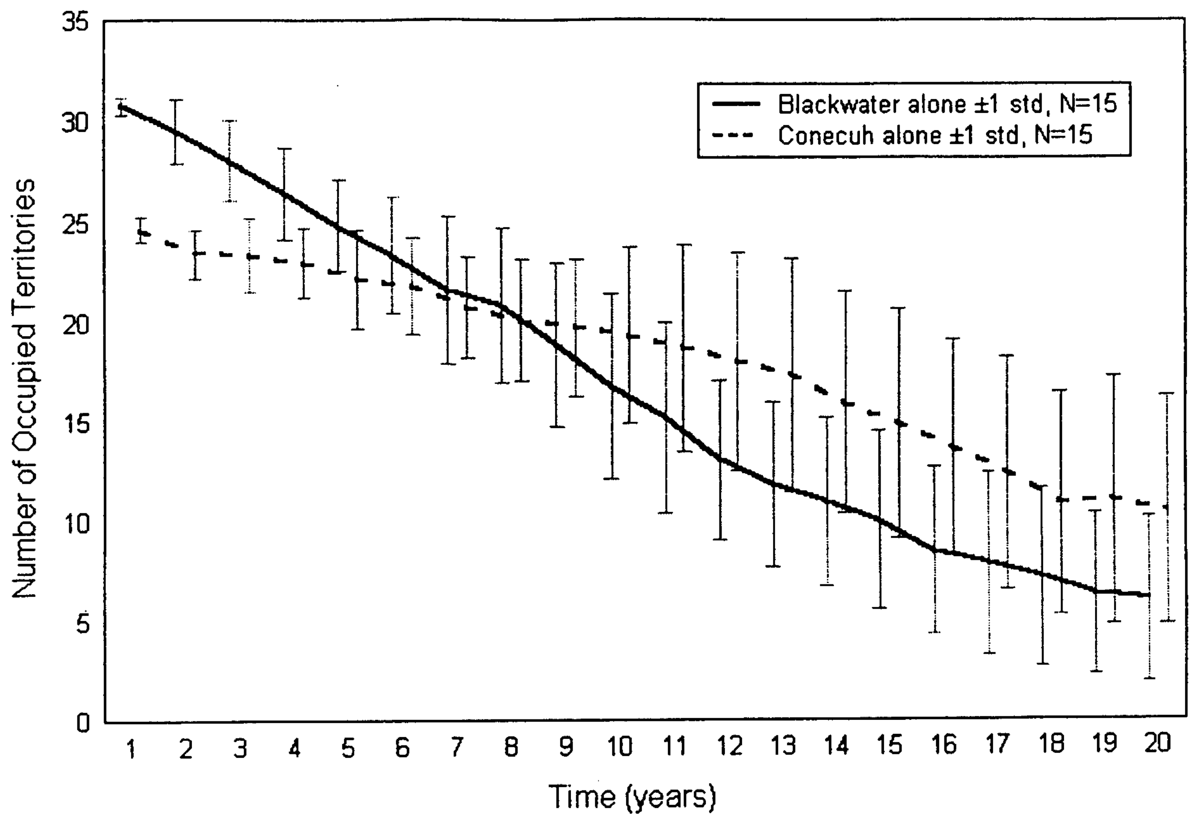


Figure 5. RCW population trends at Blackwater River State Forest and Conecuh National Forest as modeled over a 20-year period. From Priddy 1998c.

APPENDIX I. DIRECTORY OF WORKSHOP ATTENDEES:

Eglin Air Force Base Natural Resources Branch

Address:	Natural Resources 107 Highway 85 North Niceville, FL 32578
Phone:	850-882-4164
Fax:	850-882-5321
E-mail:	last name first initial@ntserver.eglin.af.mil

Natural Resources Branch	
Richard W. McWhite	Chief, Natural Resources Branch
Fire Management Branch	
James Furman	Chief, Fire Management Branch
Billy Price	Fire Management Specialist
Forestry Branch	
Stephen Seiber	Chief, Forestry Branch
Neil Hoskins	Reforestation
Scott Hassell	Timber Management, Supervisory Forester
Fish & Wildlife Branch	
Carl Petrick	Chief, Fish & Wildlife Branch
Justin Johnson	Game Biologist
Bruce Hagedorn	Endangered Species Biologist
Dennis Teague	Endangered Species Biologist
Ecological Monitoring	
Tim Christiansen (SAIC)	Ecological Monitoring
Jim Haffly	Field Technician

Tom Arrington
Florida Division of Forestry
11650 Munson Hwy.
Milton, FL 32570
Phone: 850-957-4201
Fax: 850-957-4203

Michael Barron
ATZB-PWN-R
Building 4019
Fort Benning, GA 31905
Phone: 706-544-6206

Tim Beaty
Fish & Wildlife Branch
Address: AFZP-DEV-W
Ft. Stewart, GA 31314-5000
Phone: 912-767-7261
Fax: 912-767-9433
BeatyT@EMH5.STEWART.ARMY.MIL

Scott Bebb
PWBC
Endangered Species Branch
Fort Bragg, NC 28307-5000
Phone: 910-432-5325
Fax: 910-432-7776
E-mail: bebbs@BRAGG.ARMY.MIL

Bob Bendick
The Nature Conservancy
222 S. Westmonte Drive
Suite 300
Altamonte Springs, FL 32714
Phone: 407-682-3664
Fax: 407-682-3077

Jackie Britcher
PWBC
Endangered Species Branch
Fort Bragg, NC 28307-5000
Phone: 910-432-5325
Fax: 910-432-7776
E-mail: britchej@BRAGG.ARMY.MIL

Andy Butler
RCW Research Team
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-729-3399
Fax: 850-882-5321
E-mail: abackwoods@hotmail.com

Peter Campbell
USFWS, NC Sandhills Field Station
P.O. Box 119
225 North Bennett Street
Southern Pines, NC 28388
Phone: 910-695-3323
Fax: 910-695-3322
Email: pete_campbell@fws.gov

Nicole Chadwick
Virginia Technical University
Fish and Wildlife Unit
106 Cheatam Hall
Waxford, Virginia 24060
Phone: 540-231-5703
Fax: 540-231-7580
E-mail: abryan2@vt.edu

Andrea Christman
Withlacoochie State Forest
15019 Broad St.
Brooksville, FL 34601
Phone: 352-754-6777
Fax: 352-754-6751

Andy Colaninno
National Forests in Florida
P.O. Box 579
Bristol, FL 32321
Phone: 850-643-2282
Fax: 850-643-2284
Email:
Colaninno_Andrew/r8_fl_apalachicola@fs.fed.us

Vernon Compton
The Nature Conservancy
P.O. Box 785
Milton, FL 32572-0785
Phone: 850-983-7414
Fax: 850-983-8456
E-mail: comptonv@bellsouth.net

Ralph Costa
College of Forestry & Rec. Resources
USFWS/261 Lehotsky Hall
Clemson University
Clemson, SC 29634-1003
Phone: 864-656-2432
Fax: 864-656-1350

Larry Crowder
Duke University Marine Lab
135 Duke Marine Lab Rd.
Beaufort, NC 28516-9721
Phone: 252-504-7637
Fax: 252-504-7648
Email: lcrowder@mail.duke.edu

Vic Doig
FG&FWFC
9550 NW 160th Street
Trenton, FL 32693
Phone: 352-493-6020
Fax: 352-493-6716

Todd Engstrom
Tall Timbers Research Station
Rt. 1, Box 678
Tallahassee, FL 32399
Phone: 850-893-4153
Fax: 850-668-7781

Lenny Fenimore
Choctawhatchee Audubon Society
423 Woodrow Street
Fort Walton Beach, FL 32547-2433
Phone: 850-863-2039
E-mail: LENFENIMOR@AOL.COM

Kathy Gault
RCW Research Team
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-729-3399
Fax: 850-882-5321
E-mail: kgault@Badsector.com

Jim Haffly
SAIC
107 North Highway 85
Niceville, FL 32578
Phone: 850-882-4164
Fax: 850-882-5321

Judy Hancock
FL Sierra Club
P.O. Box 2436
Lake City, FL 32056

Jeff Hardesty
The Nature Conservancy
University of Florida
Department of Botany
P.O. Box 118526
Gainesville, FL 32611
Phone: 352-392-7006
Fax: 352-846-1344
email: hardesty@botany.ufl.edu

Dennis Hardin
FL Division of Forestry
3125 Conner Blvd.
Tallahassee, FL 32399
Phone: 850-414-8293
Fax: 850-488-0863
Email: hardind@doacs.state.fl.us

Mark Herndon
NW FL Water Mgmt. Dist.
Econfina Field Office
6418 East Highway 20
Youngstown, FL 32466
Phone: 850-722-9919
Fax: 850-539-4380

Chuck Hess
USFS
P.O. Box 579
Bristol, FL 32321
Phone: 850-643-2282
Fax: 850-643-2284

Fran James
Dept. of Biological Sciences
B-142
FL State Univ.
Tallahassee, FL 32306-2034
Phone: 850-644-2217
Fax: 850-644-9829
E-mail: james@bio.fsu.edu

Bart Kicklighter
Dept. of Biological Sciences
B-142
FL State Univ.
Tallahassee, FL 32306-2034
Phone: 850-644-2217
Fax: 850-644-9829

Chris Kreh
FL Game & Freshwater Fish Commission
3911 Highway 2321
Panama City, FL 32409-1658
Phone: 850-265-3677
Fax: 850-265-5991

Rick Lint
Conecuh National Forest
Rt. 5, Box 157
Andalusia, AL 36420
Phone: 334-222-2555
Fax: 334-222-6485

Ray Moranz
The Nature Conservancy
University of Florida
Department of Botany
P.O. Box 118526
Gainesville, FL 32611
Phone: 352-392-7006
Fax: 352-846-1344
email: rmoranz@botany.ufl.edu

Lou Phillips
RCW Research Team
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-729-3399
Fax: 850-882-5321

Jeffery Priddy
Duke University Marine Laboratory
135 Duke Marine Lab Road
Beaufort, NC 28516
Phone: 252-504-7640
Fax: 252-504-7648
Email: jpriddy@mail.duke.edu

Louis Provencher
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
E-mail: tnc@nuc.net

C.F. Robinette
FL Game & Freshwater Fish Commission
3911 Highway 2321
Panama City, FL 32409-1658
Phone: 850-265-3677
Fax: 850-265-5991

Art Rohrbacher
National Forests in Florida
325 John Knox Rd., Suite F100
Tallahassee, FL 32303
Phone: 850-942-9300
Fax: 850-942-9305

Mark Sasser
FG&FWFC
c/o Florida Division of Forestry
11650 Munson Hwy.
Milton, FL 32570
Phone: 850-957-4435
Fax: 850-957-4203

William Sermons
FL Game & Fresh Water Fish Commission
Northwest Florida Region
3911 Highway 2321
Panama City, FL 32409
Phone: 850-265-3677
Fax: 850-265-5991

Dawn Simpkins
USFWS
1612 June Avenue
Panama City, FL 32405
Phone: 850-769-0552 ext. 244
Fax: 850-763-2177
E-mail:
Simpkins_Dawn/r8_fl_apalachicola@fs.fed.us

Stan Simpkins
USFWS
1612 June Avenue
Panama City, FL 32405
Phone: 850-769-0552 ext. 234
Fax: 850-763-2177

Dan Sullivan
FG&FWFC
25 Talon Drive
Crawfordville, FL 32327
Phone: 850-926-5015

Dana Timmons
Pensacola Audubon Society
P.O. Box 9283
Pensacola, FL 32513

Joseph Tomcho
RCW Research Team
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-729-3399
Fax: 850-882-5321

Eric Walters
Dept. of Biological Sciences
B-142
FL State Univ.
Tallahassee, FL 32306-2034
Phone: 850-644-2217
Fax: 850-644-9829

Jeffrey Walters
Dept. of Biology
VA Polytechnic Institute
Blacksburg, VA 24061-0406
Phone: 540-231-3847
Fax: 540-231-9307
E-mail: jrwalt@vt.edu

APPENDIX II. AGENDA

Eglin Air Force Base
Red-Cockaded Woodpecker
Management Workshop

Natural Resources Management Division (Jackson Guard) Conference Room
107 Highway 85 North
Niceville, FL

Agenda

Tuesday, July 21

10:00 am-10:15 am	Welcome and introductions (Rick McWhite) Brief account of meeting logistics (Ray Moranz)
10:15 am-10:45 am	Statement of meeting purpose and agenda; Overview of adaptive management on Eglin AFB. Overview of Eglin RCW management philosophy: objectives and progress to date (Presenter: Carl Petrick)
10:45 am-11:00 am	Overview of Gulf Coastal Plain Ecosystem Partnership and RCW management (Presenter: Dennis Hardin)
11:00 am-11:10 am	The Importance of Partnerships for RCW Conservation (Presenter: Ralph Costa)
11:10 am-12:30 pm	Review and interpret output from spatially-explicit RCW modeling effort applied to Eglin AFB-Blackwater River State Forest-Conecuh National Forest landscape • Overview of model purpose and methods • Overview of model results: -subpopulations modeled separately -subpopulations modeled together • What are the biological implications? • What other scenarios should be tested? (Presenters: Jeff Walters, Jeffrey Priddy and Larry Crowder)
1:30 pm-3:30 pm	Discuss management strategies for Eglin and for Blackwater River SF-Conecuh NF

- What are the biological advantages and disadvantages of jointly managing two or more subpopulations?
- What do model outputs suggest about landscape conservation strategies either among or within subpopulations? What other information is required?
- What are the political and legal challenges and barriers to joint management?

(Facilitators: Jeff Hardesty and Jeff Walters)

3:45 pm-5:00 pm — Continue discussion of management strategies
Review and discuss output from new model runs if available

Wednesday, July 22

8:00 am-8:30 am — Today's agenda; Overview of RCW monitoring and foraging studies and adaptive management experiment on Eglin AFB
(Presenter: Carl Petrick)

8:30 am-8:50 am — RCW inventories, monitoring and population trends on Blackwater River State Forest and Conecuh N. F.
(Presenters: Tom Arrington and Rick Lint, respectively)

8:50 am-9:10 am — RCW population trends on Eglin AFB (Presenter: Carl Petrick)

9:10 am-10:30 am — Adaptive management of RCWs on Eglin AFB

- Overview of experimental objectives and methods
- Overview of results
- What are the biological implications?
- What are the management implications?
- What are the management implications for Blackwater River SF and Conecuh NF?

(Presenter: Jeff Walters; Discussion facilitators: Jeff Walters and Jeff Hardesty)

10:45 am-Noon — Continue discussion of RCW adaptive management

1:00 pm-3:15 pm — Review and discuss a two-year foraging study on Eglin AFB

- Overview of study objectives and methods
- Overview of results
- Comparison to other studies
- What are the biological implications?
- What are the management implications?
- Discussion of habitat delineation and assessment
- Discussion of habitat management implications

(Presenter: Kathy Gault)

3:30 pm-5:00 pm	Discussion of relationships among understory cover/composition and insect productivity Overview of RCW habitat management issues

Thursday, July 23

7:45-8:00 am	Orientation to and purpose of field trip (Carl Petrick and Bruce Hagedorn)
8:00 am-Noon	Field trip to visit sites that illustrate important RCW habitat management issues: • What is the role of longleaf pine harvest in maintaining or managing RCW habitat? • What are implications of understory importance and non-fire habitat management? • How do managers prioritize burning, habitat restoration (e.g., mechanical sand pine and hardwood removal) and plantation conversion at the landscape scale?
1:00 pm-3:00 pm	RCW habitat management • List and discuss management implications • Document observations, questions and recommendations of outside reviewers (Facilitators: Carl Petrick and Jeff Hardesty)
3:15 pm-4:00 pm	Workshop wrap-up, evaluation and thank yous (Carl Petrick)
4:00 pm	End of workshop

APPENDIX III. RECOMMENDATIONS FOR MANAGEMENT OF RCW HOME RANGES AND FORAGING AREAS[4]

Our results and those of other researchers suggest that the relationships among home range size, resource quantity, habitat structure and RCW demography are complex. Nonetheless, several trends are apparent. To the extent possible, we have attempted to simplify results from this study into a set of Eglin-specific recommendations. <u>Note that these recommendations apply only to RCWs and RCW habitat occurring on Eglin AFB and should not be applied elsewhere.</u> We propose two different sets of related guidelines, one for *managing existing active clusters* and one for *evaluating potential unoccupied or abandoned habitat*. Both sets of guidelines are conservative, assuming that on Eglin the risk of setting aside too much habitat is more acceptable than the risk of conserving too little. Similarly, the suggested habitat management guidelines are also conservative; until the scientific community discerns the relationships among soil disturbance, fire history, understory cover and RCW productivity, we assume that protection of existing sites with high quality understory and restoration of lower quality sites within RCW home ranges remain high priorities. Any activities other than fire that alter understory composition or abundance in high quality sites (e.g., application of herbicides or soil disturbance) should only be undertaken when required by an activity directly related to a military mission. Lastly, we recommend that Eglin managers test the following guidelines over a six month period and where necessary make revisions consistent with the results of this study.

Guidelines for delineating foraging areas and managing individual clusters on Eglin AFB, Florida

These guidelines are to be used in evaluating the effects of proposed management actions on specific RCW groups or active clusters where the home range associated with an active cluster is *unknown* and where the home range is *known*. These guidelines are meant to assist Eglin managers in avoiding management actions that might result in take, that is, permanent abandonment of an active cluster by an RCW group. These guidelines are conservative; many stable, successfully reproducing groups on Eglin will have smaller home ranges, fewer resources, and a different habitat structure than are specified as management targets in the recommendations to follow. These recommendations recognize that management of an endangered species and its habitat are associated with uncertainty: RCW home ranges vary in size annually and seasonally, food abundance fluctuates annually and seasonally, and natural and anthropogenic perturbations may increase, reduce or limit resources, including foraging area.

These guidelines should be used in making management decisions that could result in loss of foraging habitat due to expansion of test ranges, road construction, harvest of longleaf pine[5] or similar actions. Similarly, these guidelines can be used to evaluate where and when thinning or selective harvest of longleaf in RCW foraging areas is acceptable or desirable. These guidelines will result in delineated foraging areas for each cluster, effectively creating a buffer within which existing Eglin RCW habitat management guidelines should be applied unless overridden by other issues (e.g., more restrictive management objectives).

---

[4] Appendix III was taken verbatim from pp. 27-32 in Hardesty et al. 1997a.

[5] While longleaf are specified, these recommendations apply to naturally occurring slash pine as well.

The following evaluations require use of a Geographic Information System linked to an updated stand inventory. For active clusters with *unknown* home ranges, follow steps a.–g. For active clusters with *known* home ranges, follow steps c.–g:

a) For each active cluster of concern, delineate a foraging area in the following manner: Create an ellipse with dimensions approximately equal to a ratio of 1.75:1 (width: length)[6] and equal to an area of approximately 160 ha (395 acres).[7]

b) Position the ellipse to: 1) include all active cavities and as many inactive cavities as possible; 2) exclude maximum unsuitable habitat; and 3) minimize overlap with foraging areas or home ranges of adjacent clusters. If necessary, reduce and reposition the dimensions of the ellipse such that no more than 15% overlap occurs. Calculate the area of the resulting elliptical foraging area.[8]

c) For groups with a known home range, map the home range; if the mapped area overlaps that of an adjacent delineated foraging area or home range, then divide equally the overlapping area between adjacent clusters. Calculate the home range area using a minimum convex polygon.

d) Map and determine the area of suitable habitat within the delineated foraging area or home range. Suitable habitat is defined as individual longleaf pine stands, patches or corridors with mean pine height ∃12 m, mean hardwood height #3.0 m and mean hardwood dbh #3.5 cm.[9] All suitable habitat included in calculations must be contiguous with all active cavities. Contiguous is defined as no habitat break wider than 200 meters.

e) Calculate foraging resources and constraints within delineated foraging areas or home ranges based only on mapped suitable habitat according to the following guidelines:

    i) total number of longleaf pines (∃1.4 m height) should be minimum of 29,000–38,000 stems (resource)[10]

    ii) total number of longleaf pines ∃25 cm dbh should be minimum of 6,000–10,200 stems (resource)[11] (resource)

    iii) density of longleaf pines ∃25 cm dbh should be <72 stems ha^{-1} (constraint)[12]

    iv) mean hardwood (∃1.4 m height) dbh should be #3.5 cm mean hardwood height should be #3.0 m (constraints)

---

[6] From observed mean home range width of 1786 m and length of 1019 m (n = 25 home ranges).
[7] Includes 88% of successful groups.
[8] A more conservative overlap might be 9%, the approximate average extra-territorial area recorded by Hooper et al. 1982. Among five neighboring successful clusters, we observed overlap of 11.5–47.5%.
[9] Minimum height commonly used for foraging and mean hardwood structure associated with successful groups.
[10] Lower value is mean of successful groups and upper value includes 88% of successful groups.
[11] Lower value is mean of successful groups and upper value includes 94% of successful groups.
[12] Includes 100% of successful groups.

f) If the delineated foraging area or home range contains too few resources, increase the dimensions of the ellipse, repeating steps b.–e. until both resource minimums (i. and ii.) are met or exceeded. Alternatively, achieve the minimum resource standards by including forest stands or patches outside the originally delineated area or home range if they are contiguous with suitable habitat within the delineated area or home range, and if the farthest boundary is <1.5 km (<.9 mi.) from the cavity cluster centroid.[13] In either case, stop expanding foraging area size at 200 ha.[14]

g) If the delineated foraging area, but excluding known home ranges, contains more than the required minimum foraging resources, managers may choose to reduce ellipse dimensions and repeat steps b.–e. until a resource minimum or constraint is reached or until the foraging area is 126 ha (311 acres)[15], whichever comes first.

Many delineated foraging areas and home ranges may be smaller than the recommended minimum 126 ha and may contain fewer resources. However, we recommend that Eglin managers not undertake any actions that decrease a foraging area or home range size below 126 ha or reduce the minimum resources below those described above. Clusters with apparent excess area and/or excess resources may be managed down to the recommended minimums as per step g. Management actions that cause foraging areas or home ranges to be <126 ha or lead to fewer than the recommended resources should only be considered in consultation with the USFWS.

h) When evidence of low RCW productivity exists for a given cluster, and that cluster is determined to be critical at the population level, then managers should evaluate several more intensive management options. Low RCW productivity is defined as a three year period during which fewer than three total young are fledged. Because RCW productivity may be constrained by breeder inexperience, low percent herbaceous ground cover (<40%), tall hardwood midstory (>3 m) or high pine density (>72 stems ha^{-1} of >25 cm dbh), we recommend the following management prescriptions in order of priority: 1) monitor RCWs to determine that experienced breeders are present; if they are then, 2) increase burning frequency and/or intensity, 3) if necessary, mechanically reduce oak midstory height/density using methods that do not reduce ground cover integrity or 4) consider reducing pine stands to <72 stems ha^{-1} of pines ∃25 cm dbh using means that preserve ground cover integrity, if available. Reducing oak dominance or pine density could include more intensive prescribed fire, girdling, felling, or commercial harvest; however, any of these methods should not result in substantial damage or reduction of herbaceous vegetation (e.g., reduce herbaceous cover, result in significant soil disturbance or shift ground cover dominance to ruderals). Reduction of pine density within delineated foraging areas or home ranges should

[13] Estimated: equal to two-thirds of 2.28 km, the longest possible foraging foray recorded in this study.
[14] Includes 96% of all recorded home ranges in this study.
[15] The mean home range of successful groups.

only be done under the direction of Eglin wildlife biologists and in consultation with the USFWS.

Guidelines for evaluating the foraging habitat potential of unoccupied or abandoned habitat on Eglin AFB, Florida

The purpose of these guidelines is to allow Eglin managers to evaluate currently unoccupied or abandoned habitat for its potential to support new groups established through artificial cavity construction and/or translocation. These guidelines are similar, but are less conservative. The following evaluation assumes that each potential area has suitable trees within which artificial cavities or cavity inserts can be placed.

For each potential unoccupied or abandoned area:

a) Identify the particular site intended for artificial cavity construction or the centroid of an abandoned cluster. Describe an ellipse length: width ratio of 1.75:1 and with an area of approximately 160 ha.

b) Using steps b.–e. above, estimate the quantity and structure of foraging habitat within the prescribed ellipse.

c) Using steps f. or g., adjust the size or spatial position of the ellipse to achieve the minimum resource levels, including a delineated foraging area ∃126 ha.

d) If physical barriers, such as the juxtaposition of adjacent clusters and unsuitable habitat, prohibit delineation of the minimum-sized foraging area or too few resources, then the probability of successfully establishing or reestablishing an active cluster may be low enough to warrant managers putting their resources elsewhere.

Explanation of Eglin guidelines

The RCW Recovery Plan (USFWS 1985) recommends that suitable foraging habitat should be maintained surrounding all clusters. Suitable foraging habitat is defined as 50.6 ha (125 acres) of pine or pine-hardwood forest with a pine density of 59 stems ha^{-1} ∃25 cm dbh (24 acre^{-1}). If pine density is lower, then an equivalent amount of foraging substrate should be provided over a larger area. An equivalent amount of foraging habitat should include 21,250 pine stems and a basal area of 796 m^{2}ha^{-1} (8,490 ft^{2}acre^{-1}) of pines >30 years age, and 6,350 pine stems ∃25 cm dbh.

Our recommendations are based on comparisons between successful and unsuccessful clusters. Based on data from successful groups, we recommend that RCW groups with unknown home ranges have at least 126 ha foraging areas (the mean of successful groups), but not more than 200 ha. This recommendation is contraindicated when groups already use a known smaller home range area or where existing home ranges are clearly constrained by adjacent clusters or landscape barriers. This conservative recommendation encompasses 94% of successful groups (range 67.65–248.0 ha) and all unsuccessful groups; the home ranges of successful groups were on average 46% larger and contained significantly more pine. Note also that only three of 25 Eglin groups had home ranges (51.7, 53.95, 60.1 ha) approaching the 50.6 ha recommended by

the RCW recovery plan (USFWS 1985) and all were unsuccessful. All other groups foraged over a considerably larger area. However, many groups will require fewer than 126 ha.

We also observed that while the overall density of pines was not strongly correlated to either home range size or number of fledglings produced, the density of pines ∃25 cm dbh was. Stem density of pines ∃25 cm dbh was significantly lower for successfully reproducing groups than for those that were unsuccessful. The mean density of pines ∃25 cm dbh for successful Eglin groups (48.4 stems ha^{-1}) was lower than that recommended by the recovery plan (59 stems ha^{-1}). Home range size and pine basal area were closely tied. As measures of canopy structure increased (e.g., density of pines ∃25 cm dbh, mean hardwood dbh and height), both reproduction and home range area decreased. The relationship between pine basal area and home range size was strongest when groups were unsuccessful; we found very strong evidence that reduced herbaceous ground cover, an advanced hardwood midstory and higher densities of large pines acted as a constraint to successful reproduction, but the exact causes remain elusive (see Discussion). All successful groups we observed occupied home ranges with lower basal areas than recommended in the recovery plan (14 m^2/ha (60 ft^2 acre^{-1}). Moreover, there appears to be a basal area upper limit (>9.5 m^2 ha^{-1}) beyond which we did not observe successful reproduction. However, total pine basal area per activity area was similar to that recommended by the recovery plan; half of the home ranges contained lower total basal area than recommended and half contained more. Our recommendation of #72 stems ha^{-1} of pines ∃25 cm dbh encompasses 88% of successful groups and excludes 56% of unsuccessful groups.

More importantly, our findings emphasize the importance of frequent low intensity fire and maintaining ground cover integrity. The strongest relationship among habitat and demographic variables was related to forb cover, and only secondarily to hardwood midstory and pine density. Perhaps more importantly, however, fire may determine RCW nutrition, and hence productivity, by controlling the timing, availability and quality of suitable prey. Available evidence suggests that the quality of the ground cover vegetation may be more important than the abundance of foraging substrates (see Discussion). Pines occurring at too great a density may constrain RCW productivity by constraining the extent of ground cover, and hence, prey availability. Frequent fire, especially growing season fire, can be expected to maintain intact ground cover where it exists and to restore the desired hardwood and pine structure. Over time, frequent fire is the best means of restoring understory herbaceous vegetation, particularly percent cover. Any management activities that reduce herbaceous cover (especially forb cover) may constrain RCW productivity. Preliminary data from a study of community-level response to different management treatments suggests that recovery of species richness and relative abundance may require decades (Provencher *et al.* 1996, 1997).

These recommendations should be applied and evaluated on Eglin only in an adaptive management context. Once Eglin has established a target recovery population size and distribution, and if Eglin managers can show sustained population growth and increasing density, then certain of these recommendations can most likely be relaxed. We recommend reviewing and revising these guidelines every five years.

Development Of A Spatial Forest Dynamics-Fire Model For A Sandhill Matrix Ecosystem In Northwest Florida (Eglin Air Force Base)

PROGRESS REPORT
May 15, 1998

Prepared for:

Natural Resources Branch
Eglin Air Force Base

Prepared by:

Garry Peterson, Jeffrey L. Hardesty and Doria R. Gordon

The Nature Conservancy
Public Lands Program
PO Box 118526
Dept. of Botany, University of Florida
Gainesville, FL 32611
(352) 392-7006

©The Nature Conservancy

APPENDIX C.

DEVELOPMENT OF A SPATIAL FOREST DYNAMICS-FIRE MODEL FOR A SANDHILL MATRIX ECOSYSTEM IN NORTHWEST FLORIDA (EGLIN AIR FORCE BASE).

Co-principal Investigators: Garry Peterson[1], Jeffrey L. Hardesty[2], and Doria R. Gordon[2]

ABSTRACT

Researchers developed a spatially explicit, cellular automata model for the purpose of evaluating a set of key ecological and policy questions concerning management of the 188,000 ha Eglin Air Force Base in northwest Florida. Progress to date has included 1) developing an underlying conceptual longleaf sandhill matrix ecosystem model, 2) integrating the conceptual model with an existing cellular automata computer model, 3) developing and refining parameters, and 4) running preliminary simulations to test model accuracy. The model will allow managers to conduct 'thought experiments' that test how ecosystem structure, ecological processes and human interventions may have interact to shape the current Eglin landscape and how those same forces may interact to shape future Eglin landscapes. It allows managers to vary landscape properties, such as the spatial distribution of forest types, along with the rules that govern the ecological functioning of this simulated landscape, such as fire frequency or probability of ignition. In consultation with Eglin Air Force Base and Nature Conservancy staff we developed a model that included a rough approximation of the climate and topography of Eglin. In the model, a landscape is composed of a set of vegetation states that dynamically change due to successional and disturbance processes. By way of validating and illustrating model believability, three scenarios were run in a simulated 400 km^2 landscape over a 200 year period. The simulations included: 1) historical levels of wildfire in a naturally fragmented landscape (baseline simulation), 2) reduced fire ignition probability (fire suppression) in the same landscape and 3) historical levels of fire in the same landscape, but with fire barriers (roads) added. The baseline simulation retained its original longleaf pine component, while reduced levels of fire and increased levels of fragmentation greatly increased the dominance of sand pine and hardwoods, as expected. The next steps are: 1) refine model outputs and graphics; 2) develop a user-friendly interface, emphasizing the ability to vary the range of key variables or shut features on and off; 3) develop several model landscapes based on current and historical Eglin conditions; 4) iteratively revise model parameters and run several simulations in a workshop environment with Eglin managers and other scientists; 5) develop a finite set of critical ecological and/or policy questions to be evaluated using model simulations; 6) run simulations and discuss outputs in a workshop environment with Eglin managers and other scientists; 7) discuss, evaluate and document critical interactions, insights, uncertainties and relationship of model outputs to policies and ecological knowledge.

[1] Dept. of Zoology, University of Florida, Gainesville.
[2] The Nature Conservancy, Dept. of Botany, University of Florida, Gainesville.

©The Nature Conservancy

The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies, endorsements, either expressed or implied of the AFDTC/EMSN, U.S. Air Force, or the U.S. Government.

Effort sponsored by the AFDTC/EMSN, U.S. Air Force Materiel Command, USAF, under cooperative agreement FO8635-94-2-0001, amendment D
and the U.S. Department of the Army, under cooperative agreement DAMD17-98-2-8006.
The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon.

Report prepared for:

Eglin Natural Resources Branch
AFDTC/EMSN
501 DeLeon Street, Suite 101
Eglin Air Force Base, FL 32542-5133

Report prepared by:

Garry Peterson, Jeffrey L. Hardesty, and Doria R. Gordon

The Nature Conservancy
Public Lands Program
PO Box 118526
Dept. of Botany, University of Florida
Gainesville, FL 32611
(352) 392-7006

May 15, 1998
©The Nature Conservancy

Peterson, G., J. L. Hardesty, and D. R. Gordon. 1998. Development of a spatial forest dynamics-fire model for a sandhill matrix ecosystem in northwest Florida (Eglin Air Force Base). Progress report to Eglin Air Force Base. The Nature Conservancy, Gainesville, Florida.

 ©The Nature Conservancy

TABLE OF CONTENTS

LIST OF FIGURES

©The Nature Conservancy

PROJECT BACKGROUND

Introduction

For several years the Nature Conservancy has been developing a modeling tool to examine the consequences of changing land-use and land-cover at Eglin Air Force Base. The goal of this effort has been to develop an easily modifiable simulator that managers can use in experimenting with the model Eglin landscape. The model will allow managers to conduct 'thought experiments' that test how ecosystem structure, ecological processes and human interventions may have interact to shape the current Eglin landscape and how those same forces may interact to shape future Eglin landscapes. It allows managers to vary landscape properties, such as the spatial distribution of forest types, along with the rules that govern the ecological functioning of this simulated landscape. In consultation with Eglin Air Force Base and Nature Conservancy staff we have developed a model that includes a rough approximation of the climate and topography of Eglin. In the model, a landscape is composed of a set of vegetation states that dynamically change due to successional and disturbance processes. We are still working on developing a set of policy-relevant scenarios that a user will be able to manipulate and use to conduct thought experiments.

Out main goals has been to understand how historical land-use practices have interacted with fire to shape the current Eglin landscape, and what type of future landscapes are possible with different types of management intervention. The modeling framework assists understanding by providing an organized way of synthesizing ecological knowledge. This process of synthesis allows researchers to identify how consistent these pieces of knowledge are with one another. The modeling effort has helped to integrate what is known about Eglin and its sandhill matrix ecosystem, while building an awareness of where important gaps in understanding still exist.

This paper first describes the theoretical model that exists within the computer model, before moving on to briefly describe three modeling scenarios.

MODEL ORGANIZATION

The model represents a region of Eglin Air Force Base as a rectangular matrix. Each element in the matrix, termed a site, represents an area of forest approximately 20-100 meters on edge or 0.04 -1.0 ha in area (we have not decided on a final model grain size yet, but currently are using a resolution of 60m on edge).

Each site is described by the type of forest that occupies it. It is also described by a fire history, that records the time of the last three fires, and a map of seed sources that provide potential new types of trees to the site.

A site's properties and vegetation type change over time depending upon fire frequency, sand pine invasion and forest dynamics. These vegetation types, and their transitions, are discussed in depth later in this document.

Fire and sand pine regeneration are contagious spatial processes that occur across sites in this simulated landscape. The modeled forest region experiences a climatically determined

©The Nature Conservancy

number of fire initiations each year. Eglin's topography modifies the probability that a given location is struck by lightning. Lightning may or may not initiate a fire. If it does, this fire may spread to adjacent sites. The probability of fire spreading from a burning site to an unburned site depends upon the forest type of the unburned site. A fire will continue to spread until it fails to spread to any unburned cells.

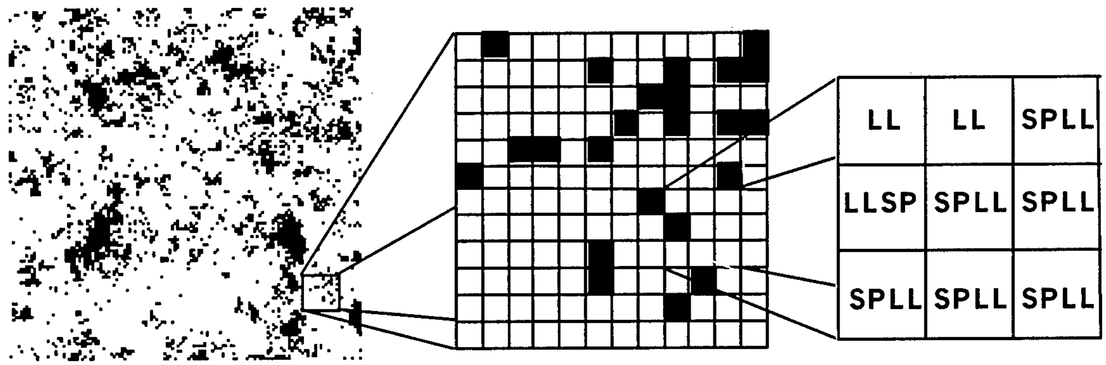


Figure 1. A sample model forest landscape composed of a matrix of sites of different forest types. Fire and sand pine propagules spread across the landscape. Sites change their type over time depending upon fire frequency and sand pine invasion. The sites making up the landscape are each shaded by forest type (where LL corresponds to longleaf pine, LLSP to longleaf pine forest that has been invaded by young sand pine, and SPLL to sand pine forest that includes some longleaf).

Changes in forest type occur based upon a simple model. In this model, the canopy of a forest patch is assumed to be composed of a mix of longleaf pine(LL), sand pine (SP) and hardwoods (HW). Thus, the content of any one patch is described by the relative proportions of these tree types. Sites can be plotted as positions within a triangle because of the assumption that the proportions of the three types comprise the total canopy (LL + SP + HW = 1.0). Changes at a site in the forest can therefore be thought of as tracing a trajectory through the triangular state space representing the various potential canopy types.

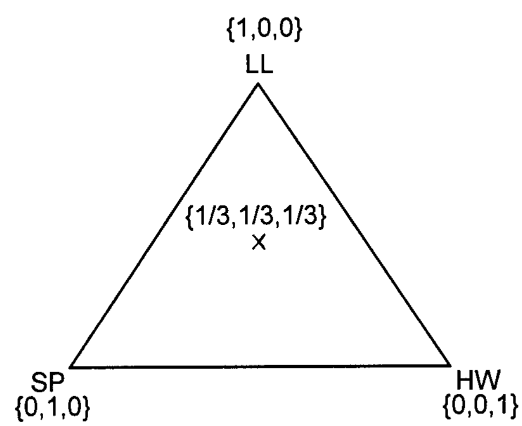


Figure 2. Canopy composition model and canopy composition at point x.

©The Nature Conservancy

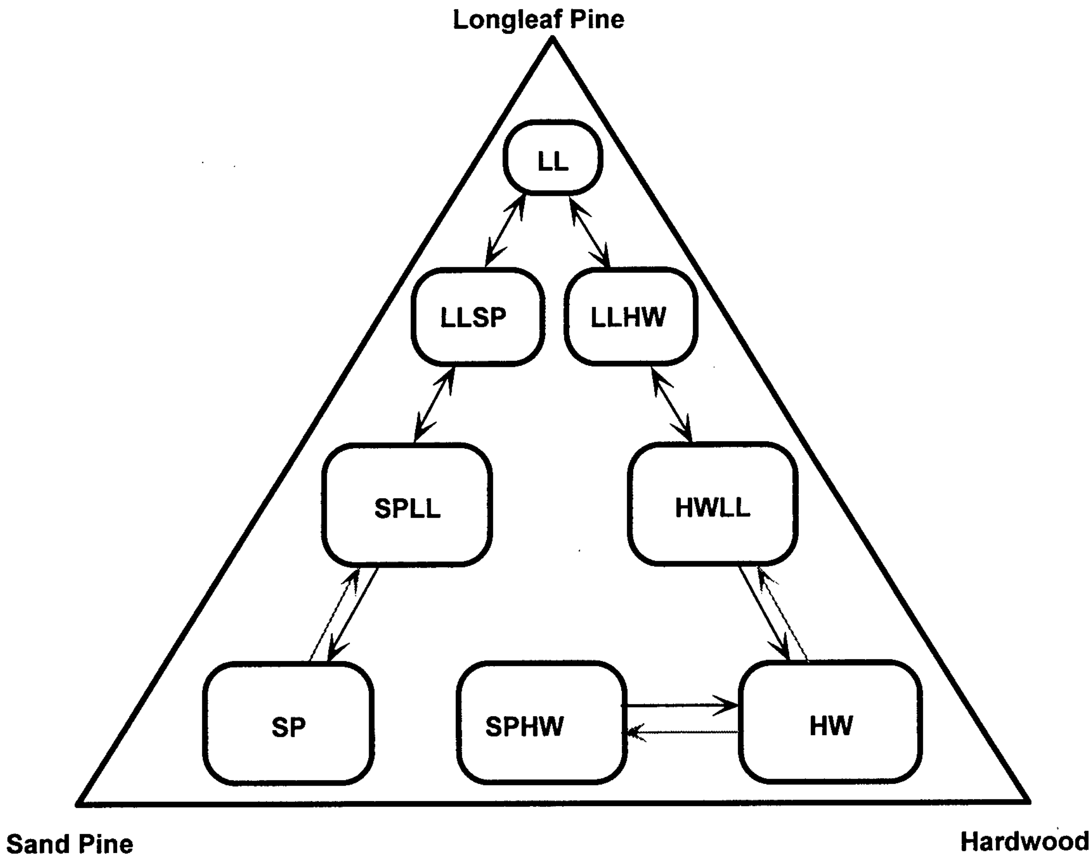


Figure 3. Conceptual state transitions.

Sandhill Transition Model States

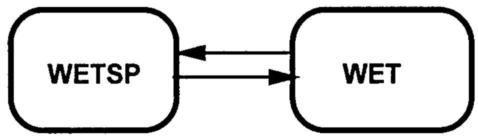
The following are verbal descriptions of state transition states:

- **LL Longleaf pine:**
  longleaf pine with recruitment, hardwood understory, continuous herb cover.
- **LLHW Longleaf pine and hardwoods:**
  longleaf pine canopy without recruitment, hardwood midstory, and discontinuous herb cover.
- **LLSP Longleaf pine and immature Sand pine:**
  longleaf pine canopy without recruitment, sexually immature sand pine present, hardwoods.
- **HWLL Hardwood/Longleaf pine:**
  hardwood and longleaf pine canopy with no longleaf recruitment, sparse herb cover.
- **SPLL Sand pine/Longleaf pine:**
  sand pine and longleaf pine canopy with no longleaf recruitment, hardwood midstory, sparse herb cover.
- **HW Hardwood:**
  hardwood canopy, with sand pine possibly present.
- **SPHW Sand pine and Hardwoods**
  mixed co-dominant sand pine and hardwood.
- **SP Sand pine:**
  sand pine canopy, with hardwood midstory.

 ©The Nature Conservancy

There are two additional wetland states that are not in the conceptual state transition model illustrated in Figure 3, but that are included in the spatial model.

WET Wetland: are wetland sites that can burn.
WETSP Wetland: with Sand pine: are wetland forest sites that include sand pine



Vegetation State Transition Rules

A site's vegetation changes from its existing state, e.g., longleaf pine, to other states, e.g., mixed longleaf-hardwood, based upon the following state transition rules. These rules are based upon the fire history of a site, and the seeds that are entering the site. However, different factors cause transitions between different states.

Longleaf
changes based upon: age

if age > 5 & near SandPine
then LL -> LLSP
if age > 15
then LLHW

Longleaf - Hardwood
changes based upon: age, lastFire

if age < 5 and last fire <5 and 2ndlast fire< 5 (3 fires all within 4 yrs of one another)
then LLHW -> LL

if age > 35
then LLHW -> HWLL

Longleaf - Sand Pine
changes based upon: age, lastFire

if age + lastfire <= 10 (two fires in ten years)
then LLSP -> LL

if age > 10 (sand pine matures)
then LLSP -> SPLL

Hardwood - Longleaf
changes based upon: age, lastFire, lastFire2, nearLongLeaf, near SandPine

if all last 3 fires occurred within 4 yrs of one another
then HWLL -> LLHW

if age > 250 and not near longleaf seeds
then HWLL -> HW

if near SandPine,
then HWLL->SPLL

Sand Pine - Longleaf
changes based upon: age, lastFire, lastFire2

if last 3 fires occurred within 4 yrs of one another
then SPLL-> LLSP
if age>250
then SPLL -> SP

Hardwood
changes based upon: age, seeds

©The Nature Conservancy

if age < 2
and near LongLeaf
then HW -> HWLL
and near sand pine
then HW -> SPHW

Sand Pine-Hardwood
changes based upon: age, near LongLeaf

if age> 250
then HWSP -> HW

if age < 2 and near LongLeaf
if fire within the past five years and near longleaf
then SPHW->SPLL

Sand Pine
changes based upon: age, nearLongLeaf

if age < 2 and near LongLeaf
if fire within the past five years and near longleaf
then SP->SPLL

Wetland
changes based upon: age, nearSandPine

if fire within last 2 years and near SandPine
then WET -> WETSP

Wetland - Sand Pine
changes based upon: age, lastFire

if two fires within last ten years
then WETSP -> WET

Seed Dispersal

Along with fire, seed dispersal is also a spatial process, which means that the seeds that enter a site are determined by the forest that surrounds it. Different tree species have different dispersal abilities. In this model, longleaf is dispersed over 40 m., while sand pine is dispersed over 80 m. HW propagules (seeds, seedlings, resprouts) are assumed to always be present. In the model, dispersal distances correspond to the 4 cell neighborhood (LL), and the 8 cell neighborhood (SP). All sites containing longleaf pine are a source of longleaf seeds (LL, LLSP, LLHW, HWLL, SPLL), and all sites containing mature sand pine are a source of sand pine seeds (SPLL, HWSP, WETSP, SP). Due the rapid rate at which sand pine matures in the absence of fire, sand pine has the potential to rapidly spread across the landscape compared to longleaf pine.

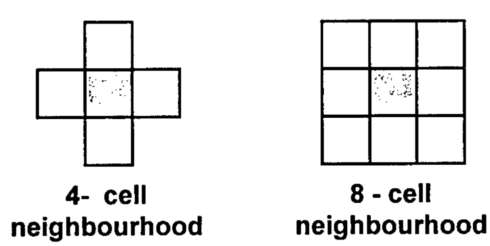


Figure 4. Four-cell neighborhood of longleaf pine vs. the eight-cell neighborhood of sand pine.

Fire

Fire is the primary way in which sites influence neighboring sites. Sites that readily propagate fire, such as longleaf sites, increase the likelihood that their neighbors will burn, while those that inhibit fire spread, such as hardwoods, decrease the likelihood that their neighbors will

 ©The Nature Conservancy

burn. Consequently, the fire regime that a site experiences is due in large part to its neighbors, and as discussed above its neighbors are determined by the fire regime. Since the ability of a site to carry fire depends on its vegetation and the time since it last burned, the ability to carry fire varies across the landscape.

Fire Initiation

Fires are initiated at random locations by lightning strikes. The base rate of initiation is 1 ignition (lighting strike)/10 km^2 (1000 ha)/yr.

Fire Spread

The ability of a site to carry fire often varies with the time since it has been burned. In North Florida, the longer the time since a site has been burned the less likely it is to carry fire in subsequent years. This occurs because if fire is excluded from a site, vegetation that inhibits the spread of fire begins to dominate that site, lowering the ability of that site to carry fire. The models used to represent these effects are outline below.

HWLL
fire spread decays as a negative exponential function of age and does not decay below the HW probability of burning.

SP & SPLL & SPHW
fire spread decays as a negative logistic function of age and does not drop below HW probability

LL & LLHW & LLSP always burns
prob = 0.25

HW
prob = 0.035

WET
follows HWLL

WETSP
follows SP

©The Nature Conservancy

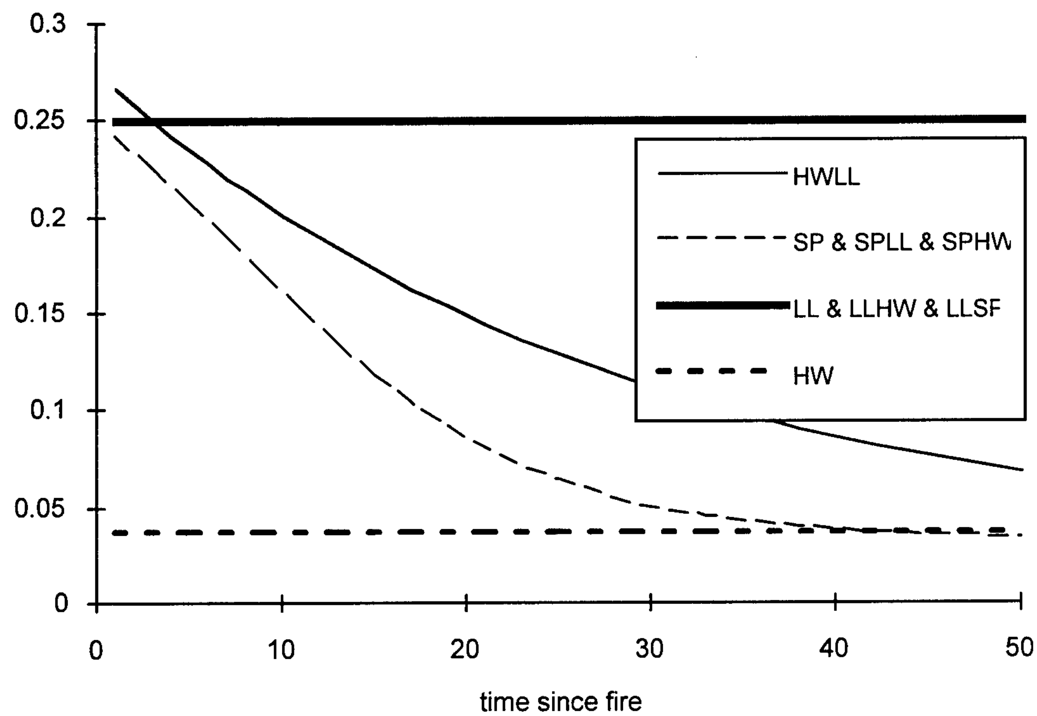


Figure 5. Model fire spread as a function of different vegetation types.

Fire spread probability and fire dynamics

The following two graphs illustrate the interactions among the likelihood of a site burning, the length of the fire front near it, and the probability of fire spreading to an adjacent cell.

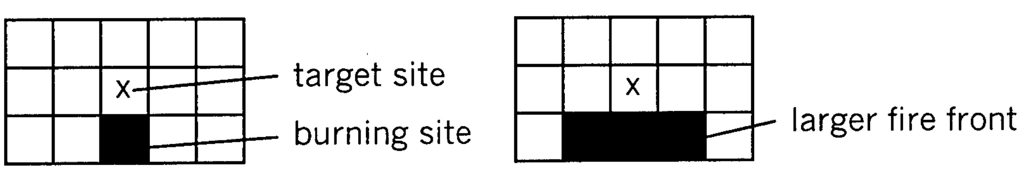


Figure 6. Model fire fronts one and 3 units wide.

The likelihood of one cell igniting a fire in a neighboring cell depends upon both the probability of fire spreading from site to site, and the size of the fire front (Fig. 5). Front size has a strong influence at small sizes, but as soon as front size becomes larger than 3 units wide, size does little to increase the likelihood of igniting a central site (Fig. 6). Secondly, one can see that the probability of fire igniting a site increases more rapidly than the probability of fire spread, but begins to level out at P = 0.25, when most fires manage to spread.

©The Nature Conservancy

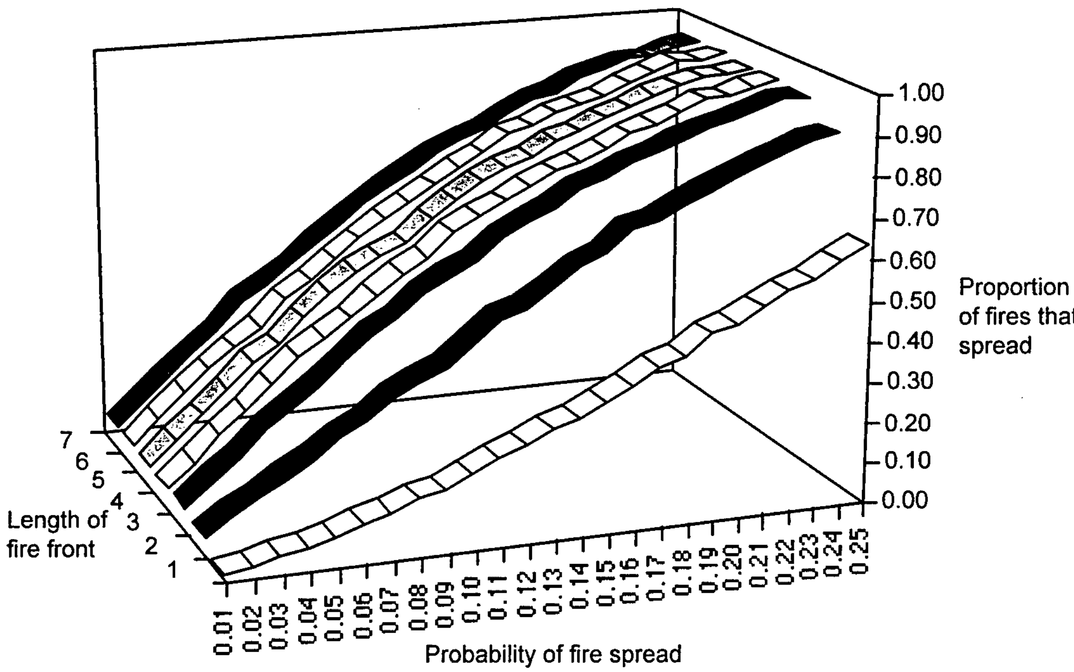


Figure 7. Probability of fire spread as a function of probability and fire front size.

The frequency with which a fire spreads is determined by the size of its fire front and the probability of fire spreading from one cell to another. The realized fire spread frequency is actually higher than the probability of fire spreading from one cell to another. This higher likelihood arises because fire can spread by several routes from one cell to another.

Since the probability of fire spread cannot exceed 1.0, no matter the size of the fire front or the probability of spread, the relative difference between actualized spread and the probability of spread declines to 1.0 as the probability of fire spread approaches 1.0.

©The Nature Conservancy

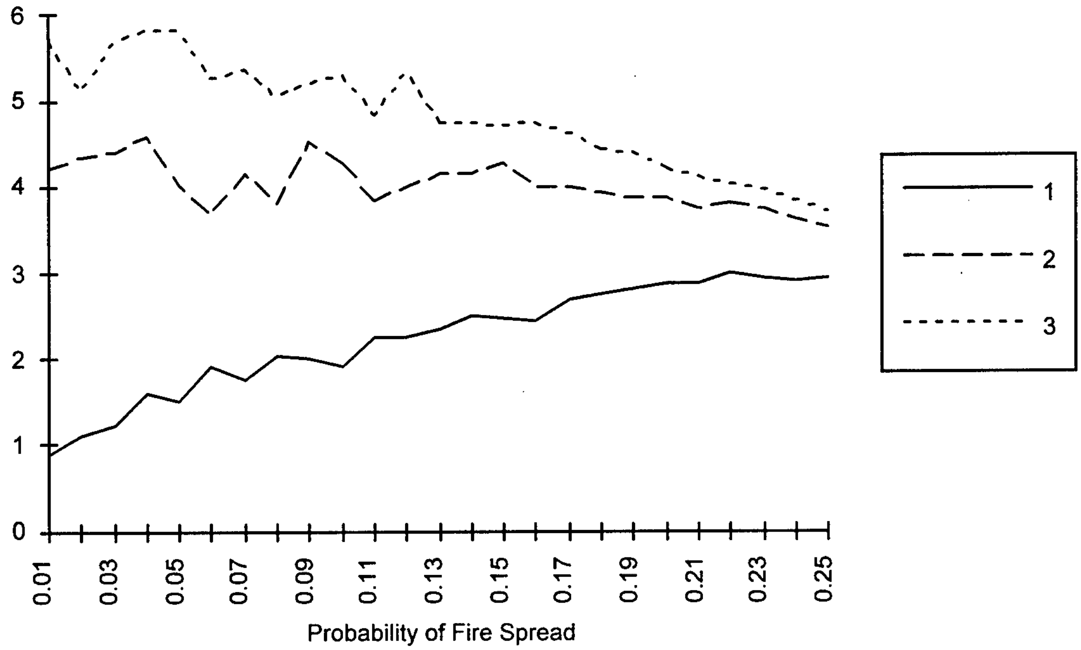


Figure 8. Fire spread frequency compared to the probability of burning a single site in a homogenous matrix of sites, for fire fronts of size one, two and three units. This figure illustrates that as the probability of fire spread increases, the size of the fire front becomes less important.

Fire Size

The potential area that can be burned by a fire is determined by the interaction of the rate at which burned vegetation becomes susceptible to fire (or looses its susceptibility), and the rate at which new fires are initiated. These relative ratios establish a maximum area that can be burned each year at equilibrium. However, realized fire size is a function of the geometry of the landscape as well as recovery and initiation rates. Several different fire scenarios are explored in the next section.

SCENARIOS

While the model is not yet complete, we developed and ran several scenarios to validate and illustrate the utility of the model for this report. We constructed and ran three scenarios in a reconstructed Eglin landscape (ATTACHMENT). The three scenarios are wildfire, fire suppression, and road fragmentation. Each of these scenarios begins with a reconstructed historical landscape. This landscape is based on current maps of topography, while the vegetation is reconstructed from a variety of historical sources using current ecological knowledge. The reconstructed landscape was based on GIS maps developed by Eglin personnel (unpub. data) and Kindell et al. (1997), and the same map was used to test monitoring parameters in Hardesty et al. (1997). Each of the scenario models was run in an approximately 20 km x 20 km watershed at 60 m x 60 m resolution for 100–200 years. We include here only three snapshots of each scenario for illustration only and provide no comparative statistics or analysis.

©The Nature Conservancy

Snapshots comparing these scenarios are found on the attachment and Quicktime movies of these scenarios are available on the world-wide-web at:

http://nersp.nerdc.ufl.edu/~arm/people/eglinScenarios.html.

Wild Fire

In this model scenario the estimated historical fire regime was allowed to continue unimpeded over time and space, except by limits dictated by topography and climate. This scenario provided some support for the model's accuracy and utility, by maintaining the presumed historical vegetation in a similar state. This case provides a baseline against which to compare the other two scenarios below.

Fire Suppression

In this scenario, the fire initiation rate is decreased 10 times, to 1 initiation/100 km^2/yr. This is meant to simulate the effects of fire suppression, by greatly reducing the number of fires that are available to spread, but not eliminating them entirely. In this scenario, while large fires continue to occur, they do not occur frequently enough to maintain longleaf pine, with the result that sandhill communities are invaded by hardwood and sand pine. Sand pine invades sandhill from riverine communities, while in upland areas hardwood grows into the canopy and midstory from its formerly suppressed state in the understory. Areas of longleaf persist for over a hundred years, but after two hundred years there are no remaining areas dominated by longleaf.

Road Fragmentation

In this scenario, the landscape has been cut into pieces by a number of roads. These roads halt the spread of fires. While the same number of fires are initiated as in the baseline scenario, the presence of roads reduces their impact on some areas of the landscape. The smaller fragments are unable to support large fires, and consequently the sites within these areas do not burn frequently enough to prevent hardwood dominance and sand pine invasion. This process occurs gradually, since fires continue to occur, but areas with greater fragmentation, e.g., those areas already fragmented by rivers, eventually lose longleaf pine dominance.

NEXT STEPS

The model is currently in an advanced state of development. The initial effort was spent 1) developing the conceptual longleaf sandhill matrix ecosystem model, 2) integrating the conceptual longleaf model with an existing cellular automata computer model, 3) developing and refining parameters, and 4) running preliminary simulations. In order to make the model useful to managers, the following steps are necessary:

1. Refine model outputs and graphics;
2. Develop a user-friendly interface, emphasizing the ability to vary the range of key variables or shut features on and off;

©The Nature Conservancy

3. Develop several model landscapes based on current and historical Eglin conditions;
4. Iteratively revise model parameters and run several simulations in a workshop environment with Eglin managers and other scientists;
5. Develop a finite set of critical ecological and/or policy questions to be evaluated using model simulations;
6. Run simulations and discuss outputs in a workshop environment with Eglin managers and other scientists;
7. Discuss, evaluate and document critical interactions, insights, uncertainties and relationship of model outputs to policies and ecological knowledge.
8. Repeat steps 4.–7. as necessary.

REFERENCES

Hardesty, J. L., D. R. Gordon, K. Poiani, and L. Provencher. 1997. Monitoring ecological condition in a northwest Florida sandhill matrix ecosystem. Final report to Natural Resources Branch, Eglin Air Force Base, Florida. The Nature Conservancy, Gainesville, Florida.

Kindell, C. E., B. J. Herring, C. Nordman, J. Jensen, A. R. Schotz, and L. G. Chafin. 1997. Natural community survey of Eglin Air Force Base, 1993-1996: Final Report. Florida Natural Areas Inventory, Tallahassee, FL.

©The Nature Conservancy

ATTACHMENT

The following attachment illustrates three model scenarios, 1) "normal" rates of wildfire in an unfragmented Eglin landscape with an estimated historical distribution of natural communities dominated by longleaf pine matrix, 2) fire suppression in an unfragmented landscape, and 3) normal rates of wildfire in a landscape fragmented by roads.

Key: bright green = longleaf, dark green = longleaf-hardwood, brown =sand pine-long leaf, red =sand pine, dark blue = hardwood-longleaf, blue = hardwood, purplish blue = hardwood-longleaf,

©The Nature Conservancy

Scenarios

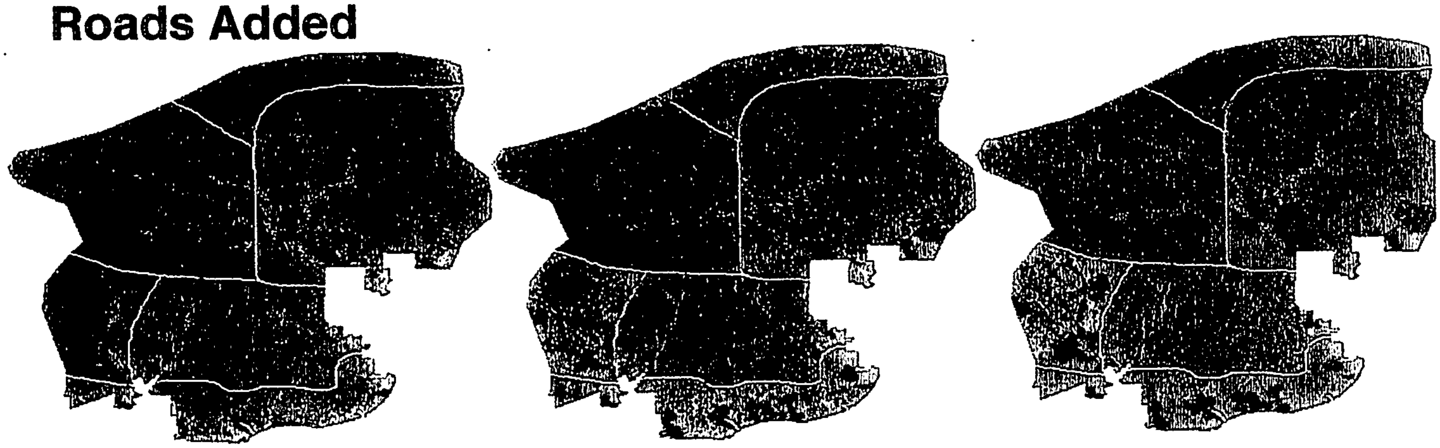
Wild Fire

Time 0 years | Time 50 years | Time 100 years

Fire Suppression

Time 0 years | Time 50 years | Time 100 years

Roads Added



Time 0 years | Time 100 years | Time 200 years

LONGLEAF PINE ECOSYSTEM RESTORATION IN NORTHWEST FLORIDA SANDHILLS: ISSUES AND RECOMMENDATIONS

SUMMARY OF THE WORKSHOP HELD AT EGLIN AIR FORCE BASE, NOVEMBER 4–6, 1998

Prepared for:

Eglin Natural Resources Branch
107 Highway 85 North
Niceville, FL 32578

Prepared by:

Jeffrey L. Hardesty & Raymond A. Moranz

The Nature Conservancy
Public Lands Program
PO Box 118526
Dept. of Botany, University of Florida
Gainesville, Florida 32611
(352) 392-7006

August 13, 1999

The Nature Conservancy.

APPENDIX D.

TABLE OF CONTENTS

OVERVIEW

Workshop objectives

Eglin Air Force Base natural resource managers invited 24 scientists and 11 managers from various federal, state and private research and conservation organizations to discuss issues related to the restoration of longleaf pine ecosystems (see the agenda in Appendix A and the participant list in Appendix B). The workshop focused on Eglin's management challenges, but many of the topics were equally germane to other longleaf pine sites. The November 4–6, 1998 workshop held at the Natural Resources Branch offices in Niceville was facilitated by staff from The Nature Conservancy. The workshop was one of a series conducted by Eglin managers as part of an on-going adaptive management process. The results are intended to support Eglin's update of their 1993–1997 Integrated Natural Resources Management Plan.

The workshop was designed to meet the following objectives:

1. Expose Eglin managers to the latest scientific information pertaining to longleaf pine ecosystem restoration;
2. Create a productive forum for exchange of information between managers and scientists;
3. Focus discussion on the most important Eglin management issues;
4. Where possible, develop specific, feasible management recommendations;
5. Document uncertainties;
6. Capture and record new information.

Workshop summary

The following workshop summary attempts to capture the most important information as transcribed by note takers and as recorded on flip charts during the meeting. Editorializing was kept to a minimum, except to add enough background information such that a decade from now a new generation of Eglin managers could read the report and understand the context of the issues and recommendations. As is typical of these summaries, some recommendations and discussion required interpretation on the part of the authors. Any errors in translation or interpretation are strictly the responsibility of the authors and do not reflect the otherwise clear thinking of Eglin managers or workshop participants. The background material comes from past workshop summaries, current projects and reports. This is not a technical report or "how to" manual, so scientific citations have been kept to a minimum and are used only when we knew the exact source. In general, comments or ideas have not been attributed to any individual.

Issues related to longleaf pine ecosystem restoration

On the first day of the workshop, Eglin managers presented their most important and urgent questions regarding longleaf pine ecosystem restoration. Following discussion, the invited scientists and managers added their concerns to the list generated by Eglin managers. To set discussion priorities during the workshop, each participant was then given 15 votes. Table 1 shows the complete list and the votes recorded for each item. Italicized items were not discussed. Finally, Eglin managers were able to add any additional items they wanted discussed regardless of the outcome of group prioritization.

Longleaf pine ecosystem restoration challenges

Eglin Air Force Base contains more than 300,000 acres of longleaf pine-dominated community types. Included are the world's most extensive remaining stands of old-growth longleaf pine. Fire-maintained xeric sandhill vegetation communities are the most common cover types at Eglin, comprising more than 78% of the Eglin terrestrial area. Sandhills can be described as forming the "matrix"[1] community type on Eglin. Other natural communities with a significant component of longleaf include wet and mesic flatwoods, upland pine forests, upland mixed forest and scrubby flatwoods. Embedded within the sandhill matrix are many "small patch" communities, including scrub, seepage slopes, sandhill upland lakes, dome swamps and xeric hammocks that, because of soils and topography, either burn less frequently or have a fundamentally different composition and structure. The sandhill uplands are dissected by numerous seepage, spring-run and blackwater streams that act to naturally fragment the uplands and curtail the spread of fire, creating "linear" vegetation communities, such as baygalls and slope and upland hardwood forests that are associated with ravines and drainages. Many of the stream systems end in basin swamps or floodplain swamps and forests associated with larger river systems, such as the Yellow River.

The landscape-level distribution of longleaf pine-dominated communities appears to have been relatively stable over the past several thousand years, as supported by paleogeographic evidence[2] and by efforts to reconstruct the distribution of historical and current Eglin vegetation using computer simulation models of landscape dynamics.[3] While prehistoric human agency may have contributed to the distribution of plant communities at the landscape-scale, modeling suggests that lightning-caused fire and subsequent fire behavior sufficiently explain how the historical distribution of plant communities was maintained in the landscape.

Eglin sandhills can be said to have multiple stable states.[4] That is, any particular sandhill site can be dominated primarily by longleaf pine or hardwoods[5] or sand pine. Complex interactions among frequent lightning and lightning initiated fires, anthropogenic fire, large and small scale wind events, landscape geometry, topography, distance from the coast, the presence of fire refugia, and periodic dry and wet years occurring over thousands of years resulted in the historical distribution of plant communities. Community composition in fire-prone sites was restricted to plants and animals that had evolved mechanisms allowing reproduction and growth to sexual maturity in the face of frequent lightning-caused fire or the periodic spread of fire from adjacent pyrogenic plant communities. In turn, the distribution of fire-adapted plant communities influenced and reinforced the spatiotemporal pattern of fire in the landscape.

Landscape-level fire suppression, anthropogenic fragmentation (e.g., roads), intensive soil disturbance and longleaf pine harvest have affected much of Eglin's longleaf pine-dominated sandhill plant communities, establishing a trajectory toward alternative stable states dominated by fire intolerant sand pine and fire resistant turkey oak-dominated communities. Once established, the structure, composition and function of these alternative systems is fundamentally

---

[1] Matrix refers to the community type most commonly found on the largest proportion of a site, and in which other communities are interdigitated or embedded.
[2] Webb 1990.
[3] Peterson et al. 1998.
[4] Peterson et al. 1998.
[5] Principally turkey oak and other deciduous oaks.

different than that of longleaf pine-dominated systems. In particular, the species-rich groundcover plant community that produces the fine fuels essential for carrying frequent, low intensity fire is suppressed, resulting in sand pine and turkey oak "barrens." Sand pine and turkey oak barrens were probably present in the prehistoric landscape, but they most likely only occurred in areas with some combination of less frequent lightning strikes and protection from the spread of fire by local topography, riparian barriers or the coastline.

Turkey oak and sand pine systems (and particularly sand pine-dominated communities) are highly resilient to perturbation and are self-replacing following major and minor disturbances (i.e., while extensive overstory mortality may occur due to wind and/or fire, oaks rapidly resprout and new sand pine stands are quickly reestablished from on-site or nearby seed sources). Fire regimes, in particular, are altered, moving from frequent, low intensity fires to much less frequent and more intensive fires that kill or topkill the majority of canopy trees. Although some relict longleaf can persist for decades in these community types, it is reasonable to suggest that most of these would be lost in the first major fire. These characteristics have important implications for future management and restoration efforts.

In general, Eglin managers are considering three restoration endpoints for longleaf pine dominated sandhills:

1. In sites with an intact groundcover community (as defined by species richness, abundance and cover) and old-growth longleaf pine present, manage for maximum system integrity using prescribed fires of variable frequency and seasonality, but that maintain a defined variation in plant cover, canopy structure and species composition;
2. In degraded sites with a high groundcover species richness, an established longleaf pine canopy, and sufficient fine fuels to carry effective frequent fires, manage both for long-term groundcover community restoration and movement toward the same prescribed fire regime as in 1. above;
3. In degraded sites with a scant understory and/or dominated by ruderal species, with or without an established longleaf pine canopy, manage for canopy reestablishment, reestablishment of an understory fine fuel matrix, and movement toward a fire regime that approaches (1.) above.

PRESCRIBED FIRE

Prescribed fire background

At present, landscape-level application of prescribed fire is constrained by existing levels of fragmentation, the uneven distribution and sizes of well-burned and less frequently burned patches, pine plantations, nearness to human infrastructure, the presence of federally listed animal species and smoke-related conflicts with the military mission. Of importance to managers, the sand pine and turkey oak-dominated systems carry uniquely different fuel loads and may that are mostly unburnable with prescribed fire or result in much hotter and more unpredictable and destructive wildfires, since fuel loads can no longer be effectively regulated using prescribed fire. Thus, the costs and risks of management increase exponentially, but unpredictably.

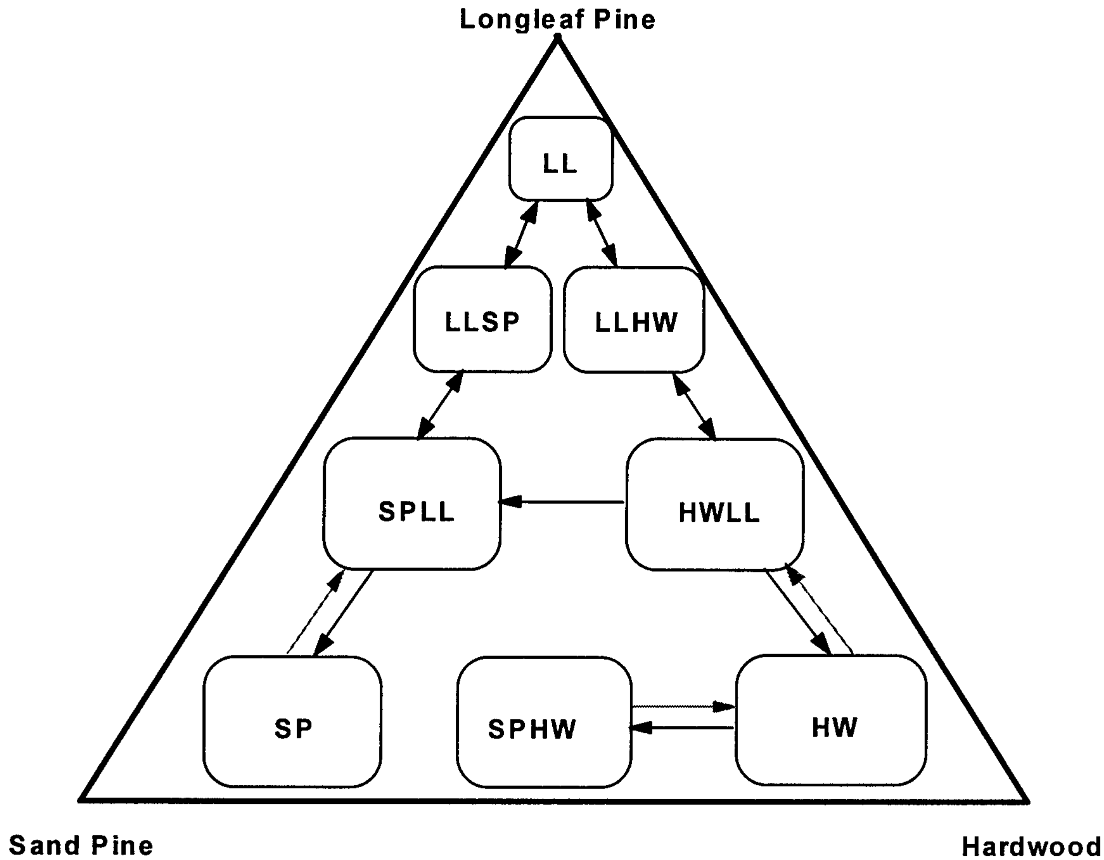


Figure 1. Conceptual model of sandhill ecosystem dynamics at Eglin. Anthropogenic disturbance (e.g., fire suppression, overharvest of longleaf pine) pushes sandhill sites toward hardwood or sand pine-dominated states that are increasingly difficult to burn, and that have fundamentally different fire dynamics, structure and composition. LL = longleaf pine, SP = sand pine, HW = hardwood.

Moreover, prescribed fire alone appears to be an insufficient restoration tool. Once the groundcover plant community is sufficiently suppressed, and oaks and sand pine reach sufficient density and size, the effectiveness of prescribed fire is reduced or use is restricted to only a handful of suitable days in any one year (Figure 1). Prescribed fire alone may be a sufficient *restoration* tool in many sandhill longleaf sites, and will nearly always be the *maintenance* tool of choice in landscapes of any size. However, manager experience—reinforced by modeling—suggests that prescribed fire alone will be insufficient to restore a landscape the size of Eglin given limitations of staff, number of suitable burning days and mission conflicts. Thus, other tools and techniques used in concert with fire are being used and tested.

Constructing a prescribed fire program in a large, human-disturbed landscape is a complex undertaking, even in the absence of external social constraints. Pressure from the Air Force to reduce the number of overtime hours, which in turn reduces the number of qualified burn leaders and workers available on any one day, appears to be the primary logistical challenge facing Eglin managers. Prescribed fire requires daily and hourly flexibility in scheduling in order

to accommodate changing weather conditions and fire behavior. Lack of flexibility will likely significantly reduce the number of acres burned on an annual and daily basis and some individual prescribed fires will not be possible.

However, the landscape itself also imposes significant constraints, primarily as a result of past management. The Eglin landscape is highly fragmented from the perspective of fire. Management units with different management histories coexist side-by-side. Sometimes adjacent units have very different maintenance or restoration requirements and objectives, oftentimes requiring different kinds of fire (e.g., oak topkill vs. overall fuel reduction) or management regimes (e.g., mechanical reduction of oak density followed by growing season fire). Ultimately, this reduces the size of burn units, constrains the number of days available for burning, increases costs and reduces the number of acres that can be prescribed burned in any one year. Additional social constraints are imposed by smoke management concerns, endangered species protection, protection of research plots and public highways.

Similarly, the oak and sand pine dominated plant communities are less biologically diverse and typically do not support large populations of even the most common species typically associated with fire-maintained longleaf pine-dominated systems. Most longleaf pine-associated plant and animal species are declining across their range and a number are federally listed.

Establishing an appropriate fire regime is a critical step in efforts to restore longleaf pine ecosystem dynamics. An "appropriate" fire regime is here defined as one that achieves the restoration goals set for system structure, composition and function at scales ranging from single longleaf stands up to and including the landscape scale, encompassing an area at least the size of Eglin. At this writing, Eglin is in the process of defining specific restoration objectives for different community types and conditions. In general, the aerial extent of longleaf restoration will encompass an area at least large enough to contain a viable population of red-cockaded woodpeckers, including allowing for stand losses due to wildfire, tornadoes, hurricanes and the military mission. Similarly, Eglin will manage for and maintain all Tier I examples of longleaf pine-dominated natural communities.

Fire return interval

Currently, Eglin's average sandhill fire return interval is difficult to estimate and varies widely across the reservation, from annual fires in areas exposed to range-related ignitions to greater than 25 years in others. In general, the average fire return interval probably averages five to ten years in sites managers are attempting to manage with intentional prescribed fire. This relatively long fire return interval reflects the complexity of managing fire on Eglin, lack of resources and tools, inadequate planning, mission-related constraints and the need for a new prescribed fire plan (presently under development). Total acres burned have ranged from <30,000 to >60,000 acres per year over the past seven years. The following recommendations resulted from discussion:

1. Decrease sandhill and flatwood fire return intervals to a planned 3-4 years in order to attain an average of 5 years or less, but flatwoods sites will require shorter intervals;
2. Variation from the desired return interval is unavoidable due to weather, social and mission constraints in some years, thus planners need not plan for variation;

3. Allowing variation in the effectiveness of *individual* burns is ecologically acceptable and managerially unavoidable, and should allow greater flexibility in firing methods and the number of burn windows available for any one unit;
4. Managers, however, should be acutely aware that variation, resulting from missed burn units and less effective than planned burns in others, is additive, and while not obvious at the burn unit-scale, accumulates rapidly at the landscape-scale (see below);
5. Eglin mangers will need to double the current prescribed fire program to 80,000–100,000 acres per year in order to meet management goals;[6]
6. Increased aerial ignitions will be required, but Eglin managers need to monitor the relative benefits of various aerial firing techniques in order to ensure that the results are desirable;
7. Because of the many sources of possible variation and inherent complexities of the Eglin fire management scenario, no specific fire management program was recommended; participants recommended continuing to use computer simulations to narrow the list of possible alternatives (see below).

Fire return intervals for specific sites will depend on site conditions, the desired structure, and whether the fire unit is in a "maintenance" or "restoration" condition. In general, units under restoration fire regimes require more frequent fire and more restrictive prescriptions. Variation in fire return intervals at various temporal and spatial scales will result from missed burn units in some years,[7] variation in the success (relative to burn objectives) of any one prescribed fire and wildfires.

Participants stated that some temporal and spatial variation in the fire regime is desirable. Small-scale patchiness was generally considered to be more desirable, while the apparent benefits of patchiness at the landscape-scale were unknown. Patchiness in individual prescribed fires or wildfires increases both horizontal and vertical structural heterogeneity at small scales within burn units, while variation in timing and placement among burn units creates patchiness at the landscape scale. However, computer simulations[8] of landscape-level fire dynamics suggested that prehistoric patchiness at the landscape-scale was mostly controlled by topography and landscape features that resulted in less frequently ignited and burned vegetation types and natural fire barriers (e.g., creeks, rivers, wetlands, coastline), rather than just fire behavior in longleaf uplands. Moreover, simulations suggested that a landscape with no or few barriers to fire was relatively homogenous at scales larger than a square kilometer, while considerable patchiness probably occurred at smaller scales. Small-scale variation may best be explained by the structural variation in vegetation at relatively small scales resulting from the behavior of fire as influenced by short-term weather events, daily variation in temperature, humidity, wind speed and direction, and pre-existing fuel types and fuel loads.

Modeling also has suggested that the introduction of variation in the fire return interval at the landscape scale (through randomly modeled missed burn units in some years) will lead to the failure of the prescribed fire program in only one or two cycles. Under the model's assumptions, managers may rapidly lose the ability to burn large blocks as hardwoods grow into the midstory

[6] As of the workshop, Eglin fire managers had tentatively adopted this goal.
[7] Primarily due to weather or mission constraints.
[8] Peterson et al. 1998.

and sand pine invades from fire refugia. Introduction of variation in burn effectiveness within burn units also decreases the ability of managers to maintain longleaf pine-dominated sandhills, but only when burn intervals exceed five years. These observations follow the recommendations of workshop participants, suggesting that fire-induced heterogeneity is desirable at small scales, but less so at large scales.

Results from running various prescribed fire management scenarios using the computer simulation model suggest that Eglin managers have two broad options when developing a fire management plan. The first (termed "rotation") divides the base into annual fire management units with each unit being burned according to a predetermined schedule (e.g., five total units in the model landscape results in a five year fire return interval when one unit is burned per year sequentially). The total number of acres scheduled to be burned in any one year (and the size of the total annual burn unit) is the total target area to be maintained by fire divided by the desired fire frequency. While the rotation method would allow for individual variation in fire conditions among subunits, it would nonetheless result in all subunits being placed on the same average schedule after two complete cycles.

The second option (termed "adaptive") prioritizes subunits by their current condition, with priority being given to those sites considered most important to managers. Higher priority sites might include red-cockaded woodpecker territories, high quality examples of selected community types or to protect the financial investment in restored sites. High priority sites are placed on a schedule sufficient to maintain desired states. Lower priority sites, many of which require more intensive restoration burns or other kinds of management, receive a lower fire priority.

These two different management regimes result in very different outcomes. All else being equal,[9] the acreage of higher quality longleaf sites increases or is maintained under the adaptive strategy, while the quality of lower priority sites is significantly reduced, essentially converting these sites to sand pine or turkey oak dominance over several burn cycles. Under the rotation strategy, the acreage of high quality longleaf sites decreases substantially, but deterioration of lower priority longleaf sites occurs at a slower rate. Modeling is currently underway as a means of selecting a better set of options.

Size of prescribed fires and burn blocks

In general, Eglin's individual prescribed fire units range in size from about 400 to 3,000+ acres. At present, many of Eglin's timber stands, and hence historical burn units, are defined by past management practices, such as longleaf, sand pine or slash pine plantations, clear cuts, test ranges and roads. Until this year, aerial prescribed fire has been greatly limited, and hence most prescribed fires have been ground operations.[10] Management objectives vary from one unit to the next, often greatly (e.g., protecting artificial regeneration in one unit, while trying to topkill hardwoods in another). Participants recommended the following:

---

[9] Assumes the same number of potential burn days per year, a fixed ratio of large burn blocks to small burn blocks, but with large burn blocks having a higher rate of variation in effectiveness.

[10] The helicopter supplied by the USFWS has been a boon to Eglin's fire program, helping them burn 18,000 acres in January alone.

1. Over a period of several complete burn cycles, vary the boundaries of burn units to avoid creating permanent "fire shadows" and artificial gradients along the edges of burn units;
2. Larger burn units are better than smaller burn units, all else being equal (see above), and burn units should be increased in size over time;
3. Adjust burn units to better manage embedded community types in order to maintain and restore gradients across different soil types and plant communities;
4. Eliminate burning constraints (different prescriptions) among adjacent units to the extent possible. Variation in management objectives and resulting prescriptions (e.g., fine-tuning burns to maximize longleaf pine regeneration across every burn unit) will constrain the number of acres burned each year because of the increased complexity;
5. Establish desired conditions and monitor progress over time; species richness was suggested as an important indicator of management success.

Season of fire

A great deal of discussion ensued concerning season of burn. In general, the consensus was that season of burn was less important than the conditions present during a prescribed fire and the type of prescribed fire used. If the primary objective is to topkill and gradually reduce the density of hardwoods under a restoration fire regime, then prescribed fires in the dormant season may be effective, although, all else being equal, growing season burns will generally achieve better results. A number of participants stated that significant topkill of hardwoods can result from intensive, hot fires applied during the dormant season. Similarly, participants agreed that topkill of oaks under growing season conditions is often unsuccessful because burn conditions or methods do not result in a high intensity fire. The key is for burn managers to understand and agree on the ecological objective for the site and to know what kinds of dormant or growing season conditions will best achieve the desired results. Generally, it was believed that dormant-season fires occurring after January 1st were more effective at topkilling oaks and sand pine. However, rotation of burn season requires that growing season fires are successful; if not, then an additional growing season fire may be required.

If the primary objective is to induce flowering of herbaceous plants, then growing season fires will be required for many target species. (Some participants noted that wiregrass flowering had been induced by intensive dormant season fires occurring during warm winter weather, but participants disagreed as to whether it would result in the production of viable seeds.) The often noted increased growth of understory plants is almost certainly a response to reduced competition for light, water and nutrients, and not to the season of burn, all else being equal. Participants generally agreed that growing season fire need only be applied once every two or three burn cycles; reducing oak or sand pine dominance and shortening the interval between prescribed fires was considered to be far more important than instituting a primarily growing season fire program at this time.

Major recommendations were as follows:

1. Focus on shortening the interval between prescribed fires, rather than on season of burn;
2. Base the season of burn on the ecological objective for the site;
3. Dormant season burns are acceptable if ecological objectives can be met;

4. Significant oak topkill can occur during dormant season fires under the appropriate conditions;
5. Growing season prescribed fires are generally required to induce flowering and fruiting of understory grasses and forbs and should still be the tool of choice under a maintenance fire regime, all else being equal (but see old growth mortality below);
6. Similarly, turkey and quail brood habitat will most likely increase in response to increased ground cover diversity, flowering and fruiting; thus, patchy growing season fires that leave some escape cover may be the best management tool for game birds.

Embedded natural communities and rare plants

At Eglin, longleaf pine-dominated sandhills provide the matrix within which many other plant communities are embedded. Some fire-maintained communities, such as seepage slopes, require the same prescribed fire treatments as surrounding sandhills. Others, such as baygalls, are relatively impervious to fire, except under extreme conditions, and probably burned every 50–100 years. Field observations (i.e., the presence of old growth longleaf pine) and modeling of the cumulative results of wildfire over periods of several decades, suggest that riparian hardwood-dominated communities have expanded their range due to fire exclusion and suppression. These sites are usually associated with creeks and ravines. In general, the many rare plants and amphibians found on Eglin are associated with more mesic sites, particularly in the dynamic ecotone between relatively wetter and drier plant communities. In addition, roads have often been sited through ecotones. Both field observations and modeling suggest that the more mesic plant communities and ecotones are least likely to receive fire under most management scenarios. In general, participants agreed that at least occasional fire was required to maintain these communities, ecotones and gradients. The conservation consequences are unknown, and these uncertainties suggest that Eglin managers need to carefully examine these questions.[11]

Participants made the following recommendations:

1. Do not purposefully ignite plant communities embedded in sandhills (e.g., during aerial ignition), but allow or encourage fire, particularly in ecotones;
2. Consider all plant communities, ecotones and gradients in burn plans;
3. Examine further the role of fire in maintaining rare plants in more mesic, less frequently burned sites;
4. Establish desired conditions for the most important plant communities (primarily those with many rare plant and animal species).

Effects on non-target animal species

In general, detrimental effects of the prescribed fire program on non-target animal species are not known. Target animal populations, such as turkey and quail, appear to have increased in response to increased fire, particularly in areas with extensive growing season fire (e.g., quail management emphasis area). The implications for management of rare amphibians (e.g., Florida bog frog and flatwood salamanders) are less well understood and participants felt this uncertainty should be addressed.

[11] An upcoming workshop on management of rare plants and plants communities has been tentatively scheduled.

Black bear conservation was raised as a potential issue, in particular, the potential for a large decrease in oak mast in successfully fire maintained uplands or a decrease in the size of hardwood dominated riparian forests. In general, participants felt that while turkey oak vertical structure may be reduced, hardwood resprouting in the understory and subsequent masting may not decrease hardwood mast overall in uplands. Also, sand live oak mast is generally considered to be more important and prescribed fires seem to have little impact on large mast producing individuals. Palmetto fruits are an important winter food source. Fire is expected to have little or no long-term effect on palmetto on Eglin and some evidence suggests that palmetto fruit production is greatest in the year following a fire and then gradually declines. A concern was also raised about black bear denning sites. However, since these sites are almost entirely restricted to the slopes and heads of steep ravines, Eglin managers feel this is not an issue, since these areas rarely, if ever, receive prescribed fire.

Major recommendations were as follows:

1. Consider black bear food sources in annual prescribed fire plans, particularly the spatial distribution of fire units in known black bear habitat.
2. Receive and review additional expert input on appropriate fire management of rare reptiles and amphibians, particularly flatwoods salamanders and the Florida bog frog.

Old-growth longleaf pine mortality

Over the past three years, Eglin managers and other researchers began noticing what they believed was an unusually high mortality of old growth (>100 years) longleaf pine following growing season prescribed fires and some wildfires. (Not surprisingly, previously turpentined trees and woodpecker cavity trees are more susceptible to prescribed fire, but the problem is equally evident among otherwise apparently healthy trees.) In some cases only single trees died, in others, patches of various sizes, up to 20 and 30 acres. Participants cited estimates of background mortality from studies conducted elsewhere that expected mortality is approximately 1% per year. The rate at Eglin appears to be significantly higher, although an estimate is not presently available. The pattern and timing of mortality varies. Some trees die in the weeks and months after a fire, others die 6-12 months after, and still others die after a second fire, sometimes three and four years after the first growing season fire. The most troubling problem appears to be mortality related to two fires, since the stage may be set for greatly increased mortality in the near future among stands currently scheduled to receive second and third prescribed fires. Potential causes of mortality include: 1) girdling of the cambium as unnaturally high fuel loads at the bases of trees are burned; 2) starvation resulting from excessive root mortality, in turn due to fire-induced heating or dehydration of feeder roots that have spread into an unnaturally thick litter layer accumulated in the absence of frequent fire; 3) death of feeder roots due to very dry pre- and/or post-fire soil moisture conditions; and/or 4) secondary pathogens.

Participants made the following recommendations:

1. Assuming that duff build-up and feeder root mortality is the primary problem, use cool fire (dormant season or when fuel moistures are high) for 2-3 cycles to gradually reduce the duff layer and allow development of feeder roots in successively deeper soils. When duff layer is substantially reduced, use higher intensity fires to achieve other objectives.

2. Examine existing historical data to better determine causes of mortality (e.g., litter moisture at the time of fire can be inferred by looking at weather data surrounding selected prescribed fires);
3. Know the spatial extent of old trees and stands by developing a GIS database to make sure that all old growth stands are considered in prescriptions;
4. As a way of beginning to get a better understanding of causes of mortality, fire managers should choose a subset of prescribed fires to measure or estimate the following parameters (pre- and post-fire where necessary):
   i) old-growth density (or mark individual trees)
   ii) duff depth
   iii) duff moisture
   iv) soil moisture
   v) KBDI
   vi) RAWS
   vii) pre- and post-fire fuel loads
   viii) fire behavior
5. Uncertainty: Eglin managers should initiate studies to better understand:
   i) What are recruitment, survival and mortality rates of old growth longleaf pine (a simple model should be used to develop appropriate hypotheses and understanding)?
   ii) What rate of loss is acceptable?
   iii) Do the same factors that kill older longleaf also have the same effect on other age classes?

Longleaf pine regeneration

Longleaf pines on Eglin typically have large mast years about once per decade, although trees produce cones in every year. However, studies cited by participants suggested that large mast years might be responsible for the majority of trees in any one stand, due in part, to the swamping of seed predators. The 1996 mast year was the largest on record. Eglin's longleaf sandhills had an average of 40,000 seedlings/acre following the 1996-mast year.[12] Fire-caused seedling mortality is context dependent, and is influenced by seedling root collar diameter, fuel loads, competition and season of fire. In long-unburned plots, fuel reduction burns typically kill 95% or more of first-year longleaf pine seedlings (observed in the TNC/Univ. of Florida/Tall Timbers RS longleaf pine restoration experiment and in other studies on Eglin and elsewhere). However, even in the absence of fire, researchers on Eglin observed 50% mortality of first-year seedlings in control plots, presumably due to competition from oaks. In sites that are in good condition due to previous burns, first-year seedling mortality was only 22% following maintenance burns. Such sites have abundant patches of bare mineral soil that do not burn; seedling mortality in these patches is much lower than 22%. In any case, participants agreed that high mortality following large mast years may have no significant long-term effect on future recruitment, since seedling densities still may be 1,000–5,000 seedlings/acre following prescribed fire. Fire-induced mortality is much less two years after establishment and in subsequent years.

[12] The Nature Conservancy, unpub. data.

In artificially regenerated sites where managers have used containerized seedlings, participants unanimously stated that sites can be burned in the year following establishment without concern for undue mortality and this should not be a constraint. Containerized longleaf should be treated no differently than naturally germinated seedlings of 3 or more years in age. Participants stated that if managers are concerned about fire anytime in the year following planting, then planting should wait until fuels, oaks or sand pine have been adequately controlled by one or more fire cycles.

Given the ecology of long-lived species such as longleaf pine, this rate of mortality is considered to be natural and the consensus opinion was that mast year seedling establishment should not constrain the prescribed fire program. Outside scientists unanimously stated that this was primarily an economic issue and not an ecological problem, meaning that the integrity of Eglin's longleaf forest would most likely not be compromised over the long-term if fire managers took only normal precautions to protect longleaf establishment in the course of prescribed fires.

Underlying this opinion, however, was the often-repeated statement by Eglin managers that future forest economics (e.g., ideal stand stocking rates) should not be a deciding factor in the management of Eglin's longleaf pine forests.[13] Participants agreed that fire managers could consider longleaf establishment so long as other arguably more important objectives could be met (e.g., topkill of oaks and sand pine). In the absence of a clear understanding of the demographics of longleaf pine on Eglin, and similarly, of articulated timber management program objectives related to longleaf pine, it was difficult for participants to evaluate the importance of this issue in the overall fire management program.

Major recommendations include the following:

1. In the absence of better information on longleaf pine mortality, and given Eglin's stated longleaf pine management philosophy, efforts to protect mast year longleaf reproduction should not be used to constrain Eglin's overall fire management program;
2. Artificially regenerated longleaf stands can be burned in the year following establishment without concern for undue mortality; if for whatever reason this is an issue, then planting should wait for one or more burn cycles until other management objectives have been met (e.g., increase fine fuels or reduce large fuels, topkill of hardwoods or sand pine);
3. Managers can and should consider longleaf recruitment in fire prescriptions, but only as a secondary objective, and so long as primary objectives can be met (i.e., topkill of oaks and sand pine);
4. Information gap: Eglin managers need to better understand the dynamics of longleaf pine demographics on Eglin. The Nature Conservancy volunteered to put together a small working group on the subject at the earliest opportunity.

[13] This statement, however, appears to be in conflict with Eglin's stated need/desire to increase timber-related revenues in the future and by constraints placed on the fire management program for the purpose of limiting seedling mortality. These issues need to be better explained and reconciled in the next iteration of the management plan.

PLANTATION CONVERSION, HARDWOOD AND SAND PINE CONTROL

Off-site slash pine plantation conversion

Approximately 22,000 acres of slash pine were planted in Eglin sandhills beginning in the 1960s. The majority of slash pine plantations do not contain merchantable wood and Eglin has been having it chipped on-site, at best a break even economic proposition. Most plantations are found in the middle portion of Eglin and most are less than 150 acres in size. The majority of these plantations are slated for conversion to longleaf pine at the earliest opportunity. All plantations were extensively site-prepared (via double roller drum chopping, disking or root raking) prior to planting. Nonetheless, some slash pine plantations have relatively well developed understory plant communities owing partly to the poor performance of the planted slash pine. In order to limit both ecological and economic costs of conversion, participants were asked to recommend more ecologically appropriate and less expensive options.

The suggested consensus approach was as follows:

1. Introduce aggressive growing season fire to begin thinning the slash pine overstory, followed by under-planting with longleaf pine.
2. This approach has other benefits, including an uneven release of longleaf seedlings as overstory slash pine suffer uneven mortality, and it protects the existing and surviving understory from additional ground disturbance due to logging or chipping operations.
3. If hardwoods are a major problem, participants suggested the use of hexazinone in a brush bullet configuration (but see below).

Controlling sand pine encroachment

Approximately 60,000 acres of former sandhills have been invaded by Choctawhatchee sand pine. Sand pine is a natural component of longleaf pine-dominated sandhills, but historically was restricted mainly to coastal plant communities, including scrub, or to sandhill ravines or others areas that naturally excluded fire. In sandhills, sand pine forms closed canopy forests with virtually no understory plants or fine fuels other than sand pine needles. Once a closed canopy of trees greater than about 10 cm (4 in) dbh is established, prescribed fire is relatively ineffective. In fact, under normal conditions, Eglin fire managers use sand pine stands as a firebreak.

This condition constitutes one of the multiple stable states described in the introduction to the report (see Overview). Sand pines reach sexual maturity at about five years, enabling rapid spread across the landscape. Computer simulations of landscape dynamics suggest that where a seed source exists, sand pine invasion is a more serious threat to the integrity of Eglin's longleaf pine-dominated sandhills than is oak encroachment alone. Many sand pine-invaded sites still have good overstories of longleaf pine with an extant, but sparse herbaceous understory. Many also have well developed oak midstories. In the absence of a natural wildfire regime allowed to operate over decades, intensive human intervention will be required to convert sand pine-invaded sites back to a longleaf pine overstory with a fire-carrying understory.

Finding ecologically and economically acceptable restoration methods is the primary management issue. The options include 1) use prescribed fire to slowly reduce the size and density of stands through repeated introduction of fire on the margins, 2) where commercially

merchantable quantities exist, contract the removal of hardwood and sand pine in pulpwood or fuelwood operations followed by repeated fire, 3) pay a contractor to fell or chip hardwoods and sand pine on site, 4) follow silvicultural operations with repeated fuel reduction and understory enhancement fires with the shortest possible return intervals, and 5) use appropriate combinations of the above, whichever is economically more feasible.

The major recommendations were:

1. Burn as far into existing sand pine-invaded sites as possible, using fire to establish the approximate boundaries of future silvicultural operations and halting continued spread;
2. Continue to contract fuelwood or pulpwood operations where economically feasible. These operations should continue to emphasize protection of extant understory plant communities by limiting soil disturbance;
3. Use proceeds from commercially viable sales to expand contracts to include girdling or felling of non-commercial quantities of hardwoods or sand pine in adjacent areas;
4. Schedule these sites for immediate fuel reduction/and or understory enhancement prescribed fires. Because of the presence of sand pine seed in the soil seed bank, these sites will require a second fire as soon as enough fine fuels have accumulated, presumably in 3 or fewer years after the initial operation;
5. Hexazinone (brushbullet only) may be used as a means of reducing hardwood density and cover within sand pine-dominated stands (but see restrictions below);
6. Because restoration will lead to a future commitment of fire program resources, the timing and location of sand pine restoration operations should be coordinated to fit within the overall fire management program and other management objectives, for example, restoration of critical RCW habitat. Uncoordinated restoration may lead to rapid reinvasion by sand pine and restoration failure.

Use of herbicide (hexazinone) to control hardwoods in sandhills

The use of herbicides (hexazinone) as a hardwood reduction tool has been debated on Eglin since at least 1991. Unfortunately, most early Eglin trial applications were done without an overall sampling or experimental design, so little was learned, other than it sometimes was effective in reducing oak densities. Because hexazinone is a relatively broad-scale herbicide, the principle concern has been the potential impact on non-target plant (and animal) species. Since 1993, two different short-term Eglin trials have shown that hexazinone does have detrimental impacts on understory plant communities (e.g., by favoring some herbaceous species over others, leading to at least a short-term reduction in richness and an altered structure), but the detrimental impacts appear to be due primarily to application methods and formulations. Trials elsewhere have shown similar results. In general, the use of "brushbullet" formulations appears to be an effective means of both reducing hardwood densities and limiting impacts on non-target plant species.

Participants emphasized that hexazinone is not a replacement for fire, particularly growing season fire if the objective is understory restoration, but rather should be seen as a one time tool used to speed the reintroduction of effective prescribed fire. Lastly, the cost of hexazinone application (approximately $40/acre) is approximately 10-20 times the cost of prescribed fire, but similar to that of mechanical operations.

Major recommendations included:

1. Herbicides should only be used as a last resort, one time tool to speed reintroduction of prescribed fire and not as a replacement for fire. Prescribed fire always should be the tool of first choice, all else being equal.
2. Establish clearly mapped "herbicide-free zones." Owing to time constraints, the workshop did not define zones. Suggested constraints include all Type I sites, known rare plant occurrences, and the presence of federally listed plant or animal species. However, these zones and constraints should be clearly and unambiguously defined prior to any further hexazinone use. Variances from permitted uses should only be the result of the consensus opinion of interdisciplinary teams, including outside experts with special knowledge of potential impacts on non-target species.
3. Use only hexazinone in a brushbullet formulation at a rate of 1 to 1.5 lbs/acre. The best application is on an approximate grid, with individual bullets placed to maximize oak mortality and limit impacts to existing groundcover. Broadcast ULW appears to have very detrimental impacts (at least in the short-term) on understory plant communities. Liquid formulations applied on a spot grid are prone to drought failure and have proven to be ineffective.
4. Develop specific prescriptions for each site. Monitor contract compliance.
5. Because all restoration treatments lead to a future commitment of fire program resources, the timing and location of hexazinone operations should be coordinated to fit within the overall fire management program and other management objectives, for example, reduction of hazardous fuels on the urban interface. Uncoordinated restoration may lead to rapid invasion by sand pine if a nearby seed source exists and numerous isolated burn units.

ROLE OF FORESTRY IN LONGLEAF PINE ECOSYSTEM RESTORATION

Age distributions in longleaf pine stands

Most of Eglin's longleaf stands are all-aged and naturally regenerated, with a few stands being relatively even-aged. Most stands have been at least selectively logged in the past. Most all-aged stands have gaps in the age structure owing to past management. Old growth (>100 years) individuals exist at low densities (1–6/acre) in the majority of stands. Eglin also contains the largest remaining old-growth stands (canopies dominated by old-growth trees), with some trees in excess of 400 years of age. The majority of these sites have been identified in the course of mapping and typing Eglin plant communities. Most of Eglin's sandhill longleaf stands are open, with a sparse but rich understory plant community consisting of 269 species of forbs, shrubs and grasses[14]. Eglin's sandhill longleaf stands also include 24 species of hardwoods, with turkey oak being most prevalent. All stands have some regeneration.

Eglin managers also have created, and are currently creating, even-aged longleaf stands of various sizes and shapes. These stands are the result of past clearcut practices or more recently, conversion of off-site pine plantations to even-aged longleaf plantations, replanting following

[14] Kindell et al. 1997

sand pine removal or replanting following hardwood reduction operations. Most of these stands or plantations are less than 10 years old.

Eglin managers wish to initiate a longleaf pine forestry program in the future, but as yet no plan has been developed. However, Eglin managers have stated that revenue production is not the most important consideration, but is one objective. Rather, Eglin managers believe that silviculture should be used as an ecological restoration tool where applicable. Several potential ecological objectives for harvesting longleaf pine have been discussed, including opening some densely stocked stands to improve RCW nesting and foraging habitat or to increase longleaf reproduction. The majority of Eglin's stands are, from a forestry perspective, lightly stocked. Relatively little is known about the demography of longleaf pine in Eglin's naturally regenerated sandhill stands (an individual-based, stand-level model is under development, but will not be usable for several years). Until Eglin managers have clearly defined an intended longleaf pine forestry program, what constitutes adequate natural regeneration, planting densities and stand age or size structure cannot be defined, except in a general sense.

Various silvicultural approaches have been suggested, but the most commonly discussed approaches center around small group or single tree selection or modified forms of shelterwood harvest. Unresolved are questions about 1) long-term impacts to understory plant and animal communities from the repeated entry required to harvest trees, 2) the economic viability of longleaf harvest on Eglin owing to its highly xeric soils and slow growth rates, and 3) the ecological costs and benefits of longleaf pine harvest.

Based on what Eglin managers have stated about the objectives of their forestry program, the consensus opinion of participants was that there is no *ecological* need to manage for any particular age or size structure in Eglin's naturally regenerated longleaf stands, other than what happens as a result of prescribed fire. (The exception to this rule is that old growth longleaf should be protected because of their unique ecological role.) The consensus opinion was that, in the absence of clearly stated stand-level ecological objectives, stand structure should not be managed for its own sake.

Xeric understory plant communities do not appear to be resilient to soil disturbance, but benefit from what is assumed to be the natural condition on Eglin; open stands consisting of widely spaced large trees, spare understory cover with significant bare sand, a low-growing, primarily understory hardwood component with few large individuals, and longleaf regeneration occurring primarily in larger canopy gaps. The majority of target animal species, including RCWs, appear to prefer these conditions. Studies at Eglin and elsewhere have shown that RCW reproduction and/or foraging are not well correlated with any of several measures of longleaf pine, including various measures of size, age, density or basal area.[15] Some stands in RCW habitat could be thinned to increase understory response or to bring densities of large trees below the recommended maximum for foraging.[16] However, these would be isolated instances and should follow the lead of Eglin's RCW managers.

---

[15] On Eglin, RCW reproductive success was only significantly and positively correlated with the percent forb cover in multiple regression of many habitat characteristics. In single regressions, reproduction also was negatively correlated with the density of large (>25 cm dbh) longleaf pines, but this relationship was not significant in multiple tests.

[16] See Hardesty et al. 1997.

Based on these discussions, the majority of participants concluded that:

1. No compelling ecological justification exists for management of any particular age or size structure in the longleaf pine forest of Eglin, with the exception of maintaining a significant component of old-growth on all or most acres;[17]
2. Participants reiterated that the most important component of Eglin's longleaf pine forest is the understory plant and animal communities. While good, proven methods are available for restoring longleaf pine trees, no widely useful methods are yet available for recreating understory plant or animal communities;
3. Manipulation of individual stands using silviculture can be used to meet clearly stated stand-level ecological objectives (e.g., isolated thinning to decrease pine density in some RCW foraging areas), but only if individual stand-level objectives, in turn, are consistent with landscape-level objectives (e.g., achieving desired longleaf density ranges in priority RCW foraging habitat);
4. Continue development of stand-level inventory. Ensure that inventory has clearly defined objectives;
5. If stand-level manipulation does occur, pre- and post-operation monitoring should be conducted to evaluate whether objectives were met.

Longleaf pine salvage logging in sandhills

Eglin managers raised the issue of whether they could conduct salvage logging of longleaf pine in all sandhill condition classes, including the highest quality sites (Type I). Secondly, participants were asked if they could identify ecological rationales for doing so.

Longleaf pines are generally resistant to most major diseases and insect infestations. The exception appears to be that individual trees frequently die from *Ips* spp., and more rarely from pine bark beetles. It is generally thought that infestation occurs in stressed trees. Stress may be caused by lightning damage, fire and competition with hardwoods or drought. Rarely do these infestations spread beyond individuals or small groups. The rates of infestation that occur at Eglin are considered to be part of the normal and probably ecologically important disturbance dynamics of longleaf pine forests (e.g., they create regeneration gaps for longleaf pine and other species, act as major foraging sites for insectivorous birds, and increase the quantity of standing and downed dead wood which provides habitat for dozens of animals species). The other major source of longleaf mortality is wildfire and prescribed fire. Areas affected range from individual trees up to more than 100 acres. No one knows if in prehistoric longleaf forests large overstory patches were killed by fire, but it seems likely that it happened at least occasionally, and may explain the presence of some apparently naturally occurring turkey oak barrens.

Nonetheless, participants could come up with no compelling ecological need or rationale for salvage logging in any forest type on Eglin. Further, participants agreed that since Type I areas are to some extent meant to act as controls, then these areas should be allowed to operate as naturally as possible. Further, salvage logging will result in understory plant community disturbance in all types. Salvage logging in marginal Type II sites may be particularly unwise since understory plant communities in this condition may be most vulnerable to soil disturbance.

---

[17] Currently defined by RCW habitat management objectives.

Salvage logging in Type III sites is acceptable if the stand is being entered for another reason (e.g., hardwood or sand pine removal operations).

The major recommendations were as follows:

1. No ecological justification exists for the need for salvage logging. Standing dead and downed longleaf limbs and boles are natural and essential elements of forest structure, and localized insect infestations and fire-caused mortality are most likely part of the natural dynamics of longleaf forests.
2. No salvage logging should occur in Type I, or probably, Type II sites.
3. Salvage logging could occur in Type III sites if the stands were being entered for another purpose such as hardwood or sand pine removal.
4. Interdisciplinary teams consisting of wildlife biologists, foresters and botanists should make consensus decisions about the acceptability of salvage logging on a case by case basis.

Use of artificial regeneration in Type I longleaf stands

Some Type I longleaf stands currently have large canopy gaps resulting from windthrow, wildfire and prescribed fire. Eglin managers wished to know if artificial regeneration was an acceptable or appropriate management tool in gaps. Some workshop participants have observed, and some studies have provided corroborating evidence, that longleaf pine forest gaps larger than about 0.3 hectares tend to become dominated by hardwoods, even in frequently burned sites (it was noted that this may be more of a problem in wetter or better soils). This appears to be primarily a problem where no or few longleaf seedlings or saplings are present in gaps (as might be the case following particularly destructive wildfires). The mechanisms are not well understood, but appear to be related to interspecific root competition; in sufficiently large gaps, hardwoods are not competing with the nearest large pines. Secondly, longleaf seed dispersal drops dramatically 100 meters from the mother tree; hence large gaps seldom receive seed. At least one participant also speculated that these gaps might be important for the establishment of perhaps otherwise rare understory species. Others questioned whether planting of seedlings would preclude capture by hardwoods. Lastly, others suggested that planting in Type I areas would confound one of the purposes of establishing Type I areas, namely, to act as reference sites. No clear consensus emerged.

Major recommendations were as follows:

1. Use site visits to establish whether hardwood "gap capture" is a major problem.
2. Consider artificial regeneration by handplanting at very low rates if the problem is widespread or due to unusual, primarily anthropogenic causes.

Future directions for forestry programs at Eglin

Over the years, Eglin managers and partners have suggested a number of alternatives for future Eglin forestry programs. Current forestry operations are focused on 1) restoration of off-site pine plantations to longleaf pine, 2) reduction of hardwood height and cover in naturally regenerated longleaf pine stands, 3) removal of sand pine from naturally regenerated longleaf pine stands, and 4) restoration of longleaf pine and removal of sand pine from previously logged sandhill sites lacking a longleaf component. These activities will continue to produce significant

revenues for the next decade or more. However, Eglin foresters also wish to eventually resume harvesting longleaf pine. In general terms, Eglin's preferred alternative has been to restore all sandhill sites to longleaf pine and, over time, use uneven-aged management techniques to sustainably harvest longleaf pine on all suitable acres (making exceptions for defined high quality sites or where harvest would preclude meeting other management objectives).

The programmatic rationale for wishing to resume longleaf harvest is to 1) use forestry on Eglin to demonstrate how wood product production can be integrated within a larger ecosystem management framework that considers a broad array of other values, including supporting the military mission and restoring the integrity of native ecosystems, and 2) to produce annual timber revenues capable of supporting important natural resource management functions.[18] Compared to more traditional even-aged techniques, uneven-aged management distributes the impacts of forestry over more acres, but with less disturbance on any one acre, in order to produce the same revenue over time. Eglin managers hypothesize that uneven-aged techniques will allow overall system integrity to improve while also producing higher value products. (As discussed in this document and elsewhere, participants in this and other workshops question whether the highly xeric soils and resulting natural community types found on Eglin can withstand the repeated entry required of uneven-aged management techniques or whether these soils can sustain a cost-effective longleaf pine forestry program. Both are key uncertainties.[19])

Participants suggested what they felt was a more ecologically and fiscally conservative alternative, given the uncertainties, that also appears to meet the same programmatic rationale:

1. Continue restoration-related forestry activities across the majority of sandhill sites until landscape-scale restoration objectives have been met.
2. Designate a small portion of already disturbed sites for intensive forestry revenue production using the most cost-effective and highest revenue producing silvicultural techniques;
3. Develop both short- and long-term product lines, including even-aged sand pine plantations and longer rotation even-aged longleaf plantations, managed for maximum production. If demonstration of uneven-aged management techniques is a goal, some proportion of plantations could be set aside for this form of management.
4. This alternative appears to limit economic uncertainty by producing an array of short- and long-term products over time, while limiting ecological uncertainty by confining the impacts of forestry operations to highly disturbed sites and conferring maximum protection to the majority of naturally managed sites.
5. Participants also noted that this option does not preclude harvests in other sites in the future, but does provide future citizens, military planners and natural resource managers with greater flexibility.

[18] Undefined to date.
[19] A study and modeling effort currently underway by Auburn researchers should shed light on this issue.

GROUNDCOVER PLANT COMMUNITIES

Recovery from soil disturbance

Throughout its range, at least 187 rare plant species have been associated with longleaf pine, making this highly varied ecosystem type one of the most diverse in North America[20]. On Eglin, as elsewhere, overall longleaf pine system diversity is a function of the exceptional diversity of plants and animals occurring in groundcover, understory plant communities. On Eglin, as many as 45 plant species have been found in a 400 m^2 plot.[21] At least 293 species of plants have been sampled on Eglin sandhill. In studies on Eglin, understory species richness and cover have been correlated with insect abundance and biomass.[22] Not coincidentally perhaps, understory herbaceous cover (specifically, forb cover) was the single, strongest environmental variable explaining RCW productivity on Eglin.[23] Fire-adapted understory species, including wiregrass and many other species, also play an important functional role, carrying frequent, low intensity fires through the understory that act to limit the dominance of competing hardwoods and sand pine, maintaining the system's characteristic savanna-like structure.

At present, relatively little information is available to suggest what type, degree or under what environmental conditions xeric groundcover plant communities can tolerate soil disturbance without fundamentally changing in structure and composition. More research has been conducted on wiregrass-dominated communities than in bluestem-dominated communities, which comprise the majority of Eglin's community types. Many types of disturbance are possible, ranging from breaking and crushing to soil compaction and uprooting. Intensive localized natural soil disturbance results from gopher tortoise and pocket gopher burrowing and tree falls. Invasive exotic animals, including feral pigs and fire ants are significant sources of soil disturbance. Anthropogenic soil disturbance has many sources, including low flotation tires on 4-wheel drive off-road vehicles, high flotation tires on logging equipment, fire plows, v-blade planting equipment, tracked vehicles, roller drum choppers and the skidding of trees to logging decks. None of these disturbance processes apparently resemble natural disturbances.

Preliminary evidence from a chronosequence study conducted on Eglin suggested that recovery to a pre-disturbance species composition and structure may take 30 years or more following selective logging with tracked vehicles.[24] Other studies cited by participants suggested a similar sequence. (Eglin manages rightly noted that higher floatation tires used on current equipment may do less damage). It was noted that recovery is significantly improved if part of an area is left undisturbed, as might be the case in carefully controlled selective logging. Of concern, participants cited studies showing that herbaceous vegetation in xeric, low nutrient sites, such as those found on Eglin, recovers significantly more slowly than that in wetter or more nutrient-rich sites. Similarly, if vegetation in hydric sites is disturbed when dry, it will recover more slowly than if disturbance occurs when the same sites are wet. (However, logging hydric sites when wet may alter surface hydrology by creating ruts and pools, channeling runoff, and locally lowering the water table.)

[20] Walker 1993.
[21] TNC, unpublished data
[22] Provencher et al. 1998.
[23] Hardesty et al. 1997.
[24] Provencher et al. 1996.

Participants were able to offer only one significant overarching management recommendation because of a fundamental lack of information, namely:

- Continue to avoid soil disturbance in areas with high quality groundcover at all costs. The exception to this rule is where soil disturbance results from the mechanical removal of sand pine or hardwoods in severely fire-suppressed sites. The understory plant/animal community consists of thousands of species; currently there are no restoration methods suitable for more than a few acres at a time, and most of these target only a handful of species. Preservation of understory communities is a more conservative approach, both ecological and economically.

Uncertainties about groundcover management

Uncertainty over recovery rates and tolerance of understory plant communities to disturbance has potentially important management implications. If in the future, managers wish to resume longleaf pine harvests then soil disturbance and loss of groundcover is unavoidable, regardless of the silvicultural technique, short of aerial logging. Understory recovery rates, presumably, should be an important factor in determining logging techniques, frequency of stand entry, and how much landscape-level disturbance is acceptable.

NEXT STEPS

Next steps are the purview of Eglin managers. Managers are presently developing the next iteration of the Eglin AFB Integrated Natural Resources Management Plan and this report and others will be used to shape management philosophies, goals and objectives. Also tentatively planned are additional workshops encompassing rare plant and plant community management, reptile and amphibian management (especially the newly listed flatwoods salamander), longleaf pine demographics and further development of the landscape dynamics simulation model.

LITERATURE CITED

Hardesty, J. L., K. E. Gault, and H. F. Percival. 1997. Ecological correlates of red-cockaded woodpecker (*Picoides borealis*) foraging preference, habitat use and home range size in northwest Florida (Eglin Air Force Base), final report. Florida Cooperative Fish and Wildlife Research Unit, University of Florida, Gainesville, FL 80 pp.

Kindell, C. E., B. J. Herring, C. Nordman, J. Jensen, A. R. Schotz, L. G. Chafin. 1997. Natural community survey of Eglin Air Force Base, 1993-1996: Final Report. Florida Natural Areas Inventory, Tallahassee, FL.

Peterson, G., J. L. Hardesty and D. R. Gordon. 1998. Development of a spatial forest dynamics-fire model for a sandhill matrix ecosystem in northwest Florida (Eglin Air Force Base). Progress Report to Natural Resources Division, Eglin Air Force Base, Florida.

Provencher, L., K. E. M. Galley, B. J. Herring, J. Sheehan, N. M. Gobris, D. R. Gordon, G. W. Tanner, J. L. Hardesty, H. L. Rodgers, J. P. McAdoo, M. N. Northrup, S. J. McAdoo, and L.

A. Brennan. 1998. Post-treatment analysis of restoration effects on soils, plants, arthropods, and birds in sandhill systems at Eglin Air Force Base, Florida. Annual report to Natural Resources Division, Eglin Air force Base, Niceville, FL. Public Lands Program, The Nature Conservancy, Gainesville, FL.

Provencher, L., D. R. Gordon, K. E. M. Galley, J. L. Hardesty, H. L. Rodgers, J. Sheehan, E. Levine, G. W. Tanner, L. A. Brennan, and K. W. Blandford. 1996. Pre-restoration analysis of plants, invertebrates, and birds in sandhill systems at Eglin Air Force Base, Florida. Annual Report to Natural Resources Division, Eglin Air Force Base, Florida.

Walker, J. 1993. Rare vascular plant taxa associated with the longleaf pine ecosystems: patterns in taxonomy and ecology. PP. 105-127 in S. M. Hermann, ed. Proceedings of the Tall Timbers Fire Ecology Conference, No. 18, The Longleaf Pine Ecosystem: ecology, restoration and management. Tall Timbers Research Station, Tallahassee, FL.

Webb, D. S. 1990. Historical biogeography. Pages 70-100 in Ecosystems of Florida, R. L. Myers and J. J. Ewel (eds.). University Presses of Florida, Gainesville, FL.

TABLES

Table 1. Prioritized list of management issues discussed during the workshop. Italicized issues were not discussed. Relative rankings by vote are in parentheses.

CATEGORY	MANAGEMENT ISSUES
Ecosystem Restoration and Fire	Prescribed fire for different communities • Sandhill fire regime (13) • Interaction between LLP regeneration and fire management (6) • Aerial burn impacts in fire shadow comm. (5) • *Should dormant season fire be used to reduce fuels after a growing season fire (4)* • *Fire intensity and frequency: Impacts on embedded communities (4)* • *Fire regimes for infrequently burned communities—Rx conflicts) (4)* • *Frequent fire impacts on conservation targets in previously impacted riparian zones (4)* • *Fire regime impacts on ecosystem processes (e.g. nutrient cycle—seed fertility) (2)* • *How to prescribe "catastrophic fire"; low intensity, high severity (1)*

Ecosystem Restoration and Fire	Prescribed fire effects on wildlife
	• Interactive effects of fire regime and behavior on life history/responses of target spp. (interval between fires for establishment) (9)
	• Is damage from plow lines worse than from wildfire? (5)
	• *Understory impacts/animal impacts resulting from*
	    • *thinning LL in Tier 2, Tier 3,*
	    • *fuelwood chip in Tier 2, Tier 3;*
	    • *SP removal in Tier 2, 3;*
	    • *Mechanical/herbicide site prep. for LL planting*
	• *Size of fire implications on wildlife (2)*
	• *Could above management impact denning bears? (0)*

Ecosystem Restoration and Fire	Effects of fire on old-growth • Loss of old-growth LLP due to recent fire (14) • impacts of expanding fire management (old growth, etc.) (10) • *Non-fire caused old-growth mortality (not immediate) (2)* • *Turpentine operation impacts on LLP mortality (0)*

<table>
<tr><th>CATEGORY</th><th>MANAGEMENT ISSUES</th></tr>
<tr><td>Ecosystem Restoration and Fire</td><td>Whether/how to develop ecological triage system for prescribed fire
System for prioritizing burns given different conditions/objectives (18)</td></tr>
<tr><td>Ecosystem Restoration and Fire</td><td>Duff/Edaphic factor interactions and effects on longleaf and other species
Fire management in old-growth LLP (11)
-KBDI prescription in areas with duff on Lakeland Sands
-better indices to indicate Rx to avoid killing LLP overstory
Duff ignition probability: how to measure it simply (1)
Soil/roots/seed effects of fire behavior variables (interaction with soil moisture) (1)
How much duff can be lost and still keep LLP overstory? (0)</td></tr>
<tr><td>Ecosystem Restoration and Fire</td><td>Wildfire
Is damage from plow lines worse than from wildfire? (5)
"Let Burn" policy: always? Sometimes? When should it be in effect for overstory protection? (3)
Wildfire impacts—fire suppression operations in Tier 1 LLP (0)</td></tr>
<tr><td>Ecosystem Restoration and Fire</td><td>Spatial configuration of fire
Given smoke management constraints, how do you meet fire objectives (size and # of fires) (3)
Spatial configuration of restoration and in context of fire (2)</td></tr>
<tr><td>Ecosystem Restoration and Sand pine/oak control</td><td>Herbicide in high-quality and in impacted sites
Herbicide use-long term impacts (13)
Can herbicide be used to:
kill stunted sand pine plantations
control hardwoods in LLP plantations
control hardwoods on test ranges
Can herbicide be used with fewer non-target impacts than chopping (11)</td></tr>
</table>

CATEGORY	MANAGEMENT ISSUES

Ecosystem Restoration and Forestry	Stand management of LL Pine and effects on understory
	
	• How to get uneven-size of LLP: thinning to J in planted or natural stands (13)
	• Natural rates of vegetation recovery from soil disturbance (8)
	• Stand structure relationship with biodiversity--density, spacing, gap characteristics
	• Scale specific LL Density objectives (added by Eglin managers)
	• What to do in Tier 1 sites where all longleaf have been killed? (added by Eglin managers)
	• How to best thin longleaf plantations for understory, RCW, etc. benefit? (added by Eglin managers)
	• Should dead longleaf be salvaged, including in Tier 1 areas? (added by Eglin managers)
	• After off-site pines/oaks have been removed, let fuel develop, burn and then plant longleaf, or plant longleaf and wait to burn? (8)
	• *How many acres to restore to LLP? (2)*
	• *Timing of restoration of LLP (0)*
	• *Understory impacts/animal impacts of*
	    • *thinning LL in Tier 2, Tier 3,*
	    • *fuelwood chip in Tier 2, Tier 3;*
	    • *SP removal in Tier 2, 3;*
	• *Mechanical/herbicide site prep. for LL planting (0)*

Ecosystem Restoration and Forestry	Timber management
	
	• *Should some of Eglin be managed for timber, and spatial configuration (4)*
	• *Revenues for sustaining forestry ops. (0)*
	• *Understory impacts/animal impacts of*
	    • *thinning LL in Tier 2, Tier 3,*
	    • *fuelwood chip in Tier 2, Tier 3;*
	    • *SP removal in Tier 2, 3;*
	• *Mechanical/herbicide site prep. for LL planting (0)*

CATEGORY	MANAGEMENT ISSUES

Ecosystem Restoration and Forestry	Sand pine management
	
	• Configuration of sand pine removal ops. (2)
	• *Should sand pine be catastrophically burned? (0)*
	• *Number of acres of sand/slash pine removal annually (0)*
	• *Understory impacts/animal impacts of*
	    • *thinning LL in Tier 2, Tier 3,*
	    • *fuelwood chip in Tier 2, Tier 3;*
	    • *SP removal in Tier 2, 3;*
	• *Mechanical/herbicide site prep. for LL planting (0)*
	• *Areas where sand pine could be controlled w/fire (LLP present) (0)*

Ecosystem Restoration and Forestry	Spatial configuration and area of off-site pine removal • Should some of Eglin be managed for timber, and spatial configuration (4) • *Spatial configuration of restoration and in context of fire (2)* • *Configuration of sand pine removal ops. (2)* • *Number of acres of sand/slash pine removal annually (0)*
Ecosystem Restoration and Forestry	• Salvage harvest impacts and when ok?
Ecosystem Restoration	Measurement of restoration success and objectives • How to know when restoration is complete (19) • *Balance between local and landscape diversity (4)* • How (methods) to bring back understory species (added by Eglin managers)
Ecosystem Restoration	• Adaptive management gaps in natural resources program (added by Eglin managers)

Ecosystem Restoration	Soil Disturbance and understory
	
	• Natural rates of vegetation recovery from soil disturbance (8)
	• Is damage from plow lines worse than from wildfire? (5)
	• *Effects of or need for chopping to remove off-site pine; non-target effects (3)*
	• *Understory impacts/animal impacts of:*
	    • *thinning LL in Tier 2, Tier 3,*
	    • *fuelwood chip in Tier 2, Tier 3;*
	    • *SP removal in Tier 2, 3;*
	• *Mechanical/herbicide site prep. for LL planting (0)*

APPENDIX A. WORKSHOP AGENDA

Time	Topic	Speaker/Facilitator
	NOVEMBER 4, 1998	
11:00 am	Lunch (Boxed lunches will be delivered; $5.50 per person)	
12:00 noon	Introduction & Welcome	Rick McWhite, Eglin AFB, and Doria Gordon, TNC
12:20 pm	Eglin AFB: An ecoregional perspective	Vernon Compton, GCPEP
12:30 pm	Overview of Eglin longleaf pine ecosystem management progress and issues	Steve Seiber, James Furman and Carl Petrick, Eglin AFB
1:40 pm	Longleaf pine ecosystem management: Common ground, conflicts and uncertainties	Discussion moderator: Doria Gordon, TNC
2:45 pm	Field trip	
	NOVEMBER 5	
8:00 am	**Ecosystem restoration and prescribed fire** Major discussion issues: • fire relative to other management objectives • longleaf regeneration and mortality • old-growth longleaf mortality • fire return intervals • how to get to maintenance? • season of burn revisited • impacts on target and non-target species Recommendations from participants Information gaps and uncertainties	Discussion moderator: Jeff Hardesty, TNC (selected participants may present relevant results from other studies)
12:30 pm	Lunch (Boxed lunches will be delivered; $5.50 per person)	
1:15 pm	**Ecosystem restoration and hardwood-sand pine-exotics control** Major discussion issues: • effectiveness of fire *vs.* other methods • herbicides: impacts on non-target plant and animal species	Discussion moderator: Jeff Hardesty, TNC (selected participants may present relevant results from other studies)

Time	Topic	Speaker/Facilitator
	• soil disturbance and understory plant and animal community restoration and recovery • is there a role for revegetation of understory? • restoration of sand pine invaded longleaf communities: appropriate methods • off-site pine plantation conversion strategies • landscape-level fragmentation Recommendations from participants Information gaps and uncertainties	

NOVEMBER 6

8:00 am	**Ecosystem restoration and longleaf pine forestry** Major discussion issues: • role and objectives of silviculture in longleaf pine ecosystem restoration and maintenance on Eglin • longleaf pine regeneration on Eglin • longleaf pine stand dynamics on xeric soils • longleaf growth rates on xeric soils and relationship to silviculture • silviculture and impacts of soil disturbance on understory plant and animal communities • longleaf pine ecosystem restoration and appropriate silvicultural techniques and tools Recommendations from participants Information gaps and uncertainties	Discussion moderator: Jeff Hardesty, TNC (selected participants may present relevant results from other studies)
12:00 noon	Lunch (Boxed lunches will be delivered; $5.50 per person)	
12:45 pm	Continue discussion of longleaf pine forestry	
2:00 pm	The workshop ends	

APPENDIX B. PARTICIPANT LIST AND CONTACT INFORMATION

Geoff Babb
The Nature Conservancy
6075 Scrub Jay Trail
Kissimmee, FL 34759
Phone: 407-935-0002
Fax: 407-935-0005
Email: gbabb@magicnet.net

Scott Berish
FL Game & Freshwater Fish Comm.
Guana River Wildlife Management Area
2690-E South Ponte Vedra Blvd.
Ponte Vedra Beach, FL 32082
Phone: 904-825-6877; suncom 865-6877
Fax: 904-825-6878
Email: Berishs@gfc.state.fl.us

William Boyer
Southern Research Station,
Andrews Forestry Sciences Lab.
520 Devall Drive
Auburn, AL 36849
Phone: 334-826-8700
Fax: 334-821-0037
Email: boyer@forestry.auburn.edu

Ken Bristol
Range Environmental Planning
46th Test Wing/XPE
101 West D Avenue, Suite 222
Eglin AFB, FL 32542
Phone: 850-882-6397
Fax: 850-882-9512
email: bristolk@eglin.af.mil

Dale Brockway
U.S. Forest Service
Southern Research Station
520 Devall Drive
Auburn, AL 36849
Phone: 334-826-8700
Fax: 334-821-0037
Email:
dbrockway/srs_auburn@fs.fed.us

Vernon Compton
The Nature Conservancy
P.O. Box 785
Milton, FL 32572-0785
Phone: 850-983-7414
Fax: 850-983-8456
Email: comptonv@bellsouth.net

Wills Flowers
F.A.M.U.
3250 Apollo Trail
Tallahassee, FL 32308
Phone: 850-561-2215
Fax: 850-561-2221
Email: rflowers@mail.istal.com

Krista Galley
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Jeff Glitzenstein
Tall Timbers Research Station
922 Seagull Drive, Apt. B
Mount Pleasant, SC 29464
Phone: 803-881-9921; 803-421-5779
Fax: 803-881-1997
Email: bluestem@mail.charleston.net

Nancy Gobris
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Doria Gordon
The Nature Conservancy
Dept. of Botany/UF
P.O. Box 118526
Gainesville, FL 32611
Phone: 352-392-5949
Fax: 352-846-1344
Email: tnc@nervm.nerdc.ufl.edu

Mark Hainds
The Longleaf Alliance
Route 7, Box 131
Andalusia, AL 36420-9025
Phone: 334-222-7779
Fax: 334-222-0581
Email: hainds@alaweb.com

Jeffrey Hardesty
The Nature Conservancy
Dept. of Botany/UF
P.O. Box 118526
Gainesville, FL 32611
Phone: 352-392-7006
Fax: 352-846-1344
Email: hardesty@botany.ufl.edu

Brenda Herring
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Rhett Johnson
Dixon Center, Longleaf Alliance
Route 7, Box 131
Andalusia, AL 36420
Phone: 334-222-7779
Fax: 334-222-0581
Email: johnson@forestry.auburn.edu

Carolyn Kindell
Florida Natural Areas Inventory
1018 Thomasville Road, Suite 200-C
Tallahassee, FL 32303-6237
Phone: 850-224-8207
Fax: 850-681-9364
Email: ckindell@fnai.org

John Klempa
Florida Division of Forestry
11650 Munson Hwy
Milton, FL 32570
Phone: 850-957-4201
Fax: 850-957-4203

John Kush
School of Forestry
108 M.W. Smith Hall
Auburn University, AL 36849
Phone: 334-844-1065
Fax: 334-844-1084
Email: kush@forestry.auburn.edu

Gretchen LeBuhn
Florida State University
Department of Biol. Sciences
Tallahassee, FL 32306
Phone: 850-644-9824
Fax: 850-644-9844
Email: lebuhn@bio.fsu.edu

Andrea Litt
Dept. of Wildlife Ecology &
Conservation
P.O. Box 110430
University of Florida
Gainesville, FL 32611
Phone: 352-846-0643
Fax: 352-392-6984
Email: alitt@nervm.nerdc.ufl.edu

Jeff McAdoo
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Senta McAdoo
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Ralph Meldahl
School of Forestry
108 M.W. Smith Hall
Auburn University
Auburn, AL 36849-5418
Phone: 334-844-1060
Fax: 334-844-1084
Email: meldahl@forestry.auburn.edu

Erica Mitchell
Science Applications International
Corporation
630-C Anchors St.
Fort Walton Beach, FL 32548
Phone: 850-986-2142
Fax: 850-243-7724
Email:
ERICA.L.MITCHELL@cpmx.saic.com

Ray Moranz
The Nature Conservancy
Dept. of Botany/UF
P.O. Box 118526
Gainesville, FL 32611-8526
Phone: 352-392-7006
Fax: 352-846-1344
Email: rmoranz@botany.ufl.edu

Keith Moser
Tall Timbers Research Station
Rt. 1, Box 678
Tallahassee, FL 32399
Phone: 850-893-4153
Fax: 850-668-7781
Email: 4ester@compuserve.com

Molly Northrup
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Ken Outcalt
U.S. Forest Service
Forest Sciences Lab
320 Green St.
Athens, GA 30602-2044
Phone: 706-559-4309
Fax: 706-559-4311
Email: koutcalt/srs_athens@fs.fed.us

Dale Pancake
Dixon Forestry Center
Rt. 7 Box 131
Andalusia, AL 36420
Phone: 334-222-7779
Fax: 334-222-0581

David Printiss
Florida Natural Areas Inventory
1018 Thomasville Rd.
Tallahassee, FL 32303-6237
Phone: 850-224-8207
Fax: 681-9364
Email: Dprint@ibm.net

Louis Provencher
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: tnc@nuc.net

Jim Sheehan
Longleaf Pine Restoration Project
P.O. Box 875
Niceville, FL 32588-0875
Phone: 850-883-6089/850-689-3669
Fax: 850-689-3669
Email: longleaf@nuc.net

Rick Studenmund
Apalachicola Bluffs & Ravines Preserve
P.O. Box 393
Bristol, FL 32321-0393
Phone: 850-643-2756
Fax: 850-643-5246
Email: rstudenmund@nettally.com

George Tanner
Dept. of Wildlife Ecology &
Conservation
P.O. Box 110430
University of Florida
Gainesville, FL 32611
Phone: 352-846-0570
Fax: 352-392-6984
Email: tannerg@wec.ufl.edu

Bruce Zutter
School of Forestry
108 M.W. Smith Hall
Auburn University
Auburn, AL 36849-5418
Phone: 334-844-1033
Fax: 334-844-1084
Email: zutter@forestry.auburn.edu